SCHOOL OF CIVIL ENGINEERING

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ENGINEERING SOILS MAP OF BLACKFORD COUNTY, INDIANA

FINAL REPORT

Andrew Garrigus

PURDUE UNIVERSITY

Final Report

ENGINEERING SOILS MAP OF BLACKFORD COUNTY, INDIANA

TO:	H. L. Michael, Director Joint Highway Research Project	February 15, 1990 Project: C-36-51-B
FROM:	Robert D. Miles, Research Engineer Joint Highway Research Project	File: 1-5-2-8

This report entitled "Engineering Soils Map of Blackford County, Indiana," completes a portion of the long-term project concerned with the development of county engineering soils maps of the 92 counties in the state of Indiana. This is the 86th report of the series. The report was prepared by Andrew Garrigus, Research Assistant, Joint Highway Research Project, under my direction.

The soils mapping of Blackford County was done primarily by the analysis of landforms and associated parent materials as portrayed on stereoscopic aerial photographs. Extensive additional information on the soils was obtained from the soil survey and publications of the Soil Conservation Service, USDA. Test data from roadway and bridge projects was supplied by IDOT. Generalized soil profiles for the landform/parent material areas mapped are shown on the engineering soils map. A print of the engineering soils map of Blackford County is included at the end of the report.

Respectfully submitted,

Robert D. Miles

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FINAL REPORT

ENGINEERING SOILS MAP OF BLACKFORD COUNTY, INDIANA

by

Andrew Garrigus
Research Assistant

Joint Highway Research Project

Project No.: C-36-51-B

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ACKNOWLEDGEMENTS

The author would like to thank Professor R.D. Miles and Professor C.W. Lovell for the opportunity to work on this project and their assistance during its duration. Recognition also goes to Professor H. L. Michael, Director, Joint Highway Research Project, and the other members of the Joint Highway Research Board for their continued support of the county soil mapping project.

The author is indebted to his colleagues, Arvind Chaturvedi and Barbara Schmidt, for their assistance and helpful discussions. Acknowledgement goes to Xue Weiqing and Mei Zhang for drafting the map and figures of this report. Thanks also go to Cheryl Henson for typing the classification test results presented in Appendix A and to Will McDermott and Marian Sipes for formatting the text and the final preparation of this report.

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ENGINEERING SOILS MAP
OF
BLACKFORD COUNTY

INTRODUCTION

The engineering soils map of Blackford County, Indiana, which accompanies this report was prepared primarily by airphoto interpretation techniques using accepted principles of observation and inference. The 7-inch by 9-inch aerial photographs used in this study, having an approximate scale of 1:20,000, were taken in the summer of 1941 for the United States Department of Agriculture and were purchased from that agency. The attached engineering soils map was prepared at a scale of 1:63,360 (1 inch = 1 mile).

Standard symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were employed to delineate landform-parent material associations and soil textures. The text of this report represents an effort to overcome the limitations imposed by adherence to a standard symbolism and map presentation.

Extensive use was made of the Agricultural Soil Survey of Blackford/Jay County published in 1986 (1)[*]. It was particularly useful as a cross-reference to check soil boundaries and in locating water bodies, gravel pits, and quarries not present on the 1941 aerial photographs. Also, a reconnaissance field trip was made to the county in the earlier stages of the work.

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[*] Numbers in parentheses refer to items in the list of references.

The map and report are part of a continuing effort to complete a comprehensive engineering soil survey for the state of Indiana. In completing this task, a consistent mapping of soil units at the boundaries of previously mapped Grant and Delaware counties was attempted. At the time of writing of this report, the two other adjacent counties, Jay and Wells, were unmapped.

Included on the map is a set of subsurface profiles which represent the approximate variations that are expected in the general soil profiles of the major soils of each landform-parent material region. The profiles were constructed from information obtained from boring data collected from bridge and roadway site investigations (25-32) and agricultural literature. Boring locations are shown on the map, and Appendix A contains a summary of classification test results for these locations.

The text of this report supplements the engineering soils map and includes a general description of Blackford County, descriptions of the different landform-parent material areas, and a discussion of the engineering considerations associated with the soils of Blackford County.

The predominant agricultural soils associated with each landform-parent material class are covered in the discussion of each of the different landforms in the county. The physical, chemical, and engineering index properties are included in Appendices B and C.

DESCRIPTION OF THE AREA

GENERAL

Blackford County is located in northeastern Indiana as shown in Figure 1. Blackford County is bordered on the south by Delaware County, to the east by Jay County, to the north by Wells County, and to the west by Grant County. Hartford City is the county seat of Blackford County and is located along Big Lick Creek in the west-central part of the county. Hartford City was incorporated in 1857 and enjoyed an early growth due to the discovery of natural gas and oil (5).

The county is about 13 miles square and has an area of approximately 168 square miles (106,022 acres). The Godfrey Reserve, located southeast of Montpelier, disrupts the standard public land section grid pattern.

Blackford County is served by two railroads. Conrail provides service to western points through Chicago, Illinois, and to eastern points through Columbus, Ohio. Southern and Norfolk provide freight service to Indianapolis, Fort Wayne, Muncie, and other points. There are 44 miles of federal and state roads and 330 miles of county roads in Blackford County (1). Many of the county roads are paved while the rest are gravel. There are also many private airstrips in the county (1).

In 1980, the population of Blackford County was 15,570. This was a two percent decrease from the 1970 population and a five percent increase from the 1960 population. A population summary of the major towns and cities in Blackford County is given in Table 1.

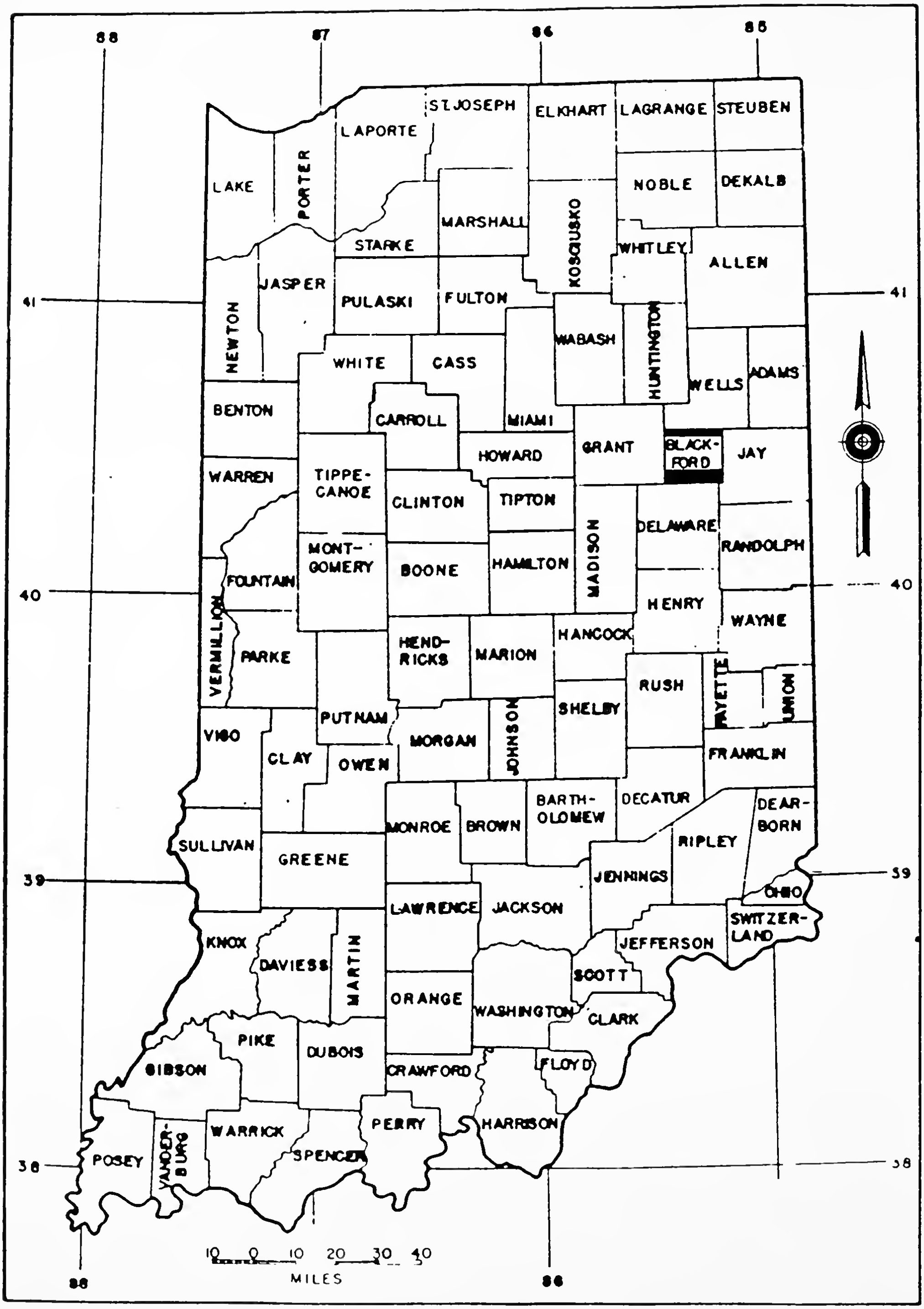


Figure 1 Location Map of Blackford County.

TABLE 1. POPULATION SUMMARY OF BLACKFORD COUNTY (3)

	Population		Population Change (1970-1980)	
	1980	1970		
City/Town	Census	Census	Difference	Pct.
Hartford City	7,622	8,207	-585	-7.13
Montpelier	1,995	2,093	-98	-4.68
Shamrock Lakes	206			
Cities and Towns	9,823	10,300	-477	-4.63
Rural Areas	5,747	5.588	159	2.85
County Total	15,570	15,588	-316	-2.00

Most of the land in Blackford County is actively farmed. The principal crops are corn, soybeans, and wheat. Hogs, beef, and some dairy operations are the main source of income for livestock farmers in Blackford County. Most people earn their living by farming, raising livestock, or by commuting to Muncie and Marion in adjacent counties for work (1).

CLIMATE

Blackford County is located in a region of temperate climate with hot humid summers and cold winters. Tables 2 and 3 give data on temperature and precipitation for the area as recorded in Berne,Indiana for the period 1951 to 1980.

In winter, the average temperature is 28 degrees F, with a record low being -18 degrees F. The average summer temperature is 72 degrees F with an average daily maximum temperature of 84 degrees F. The highest recorded temperature is 101 degrees F (1).

The total annual precipitation is 36.36 inches with sixty percent of that falling between April and September. The average seasonal snowfall is 29 inches. Thunderstorms occur on nearly 40 days a year. Tornados and severe thunderstorms also occur occasionally and can result in damage to persons and property. The prevailing wind is from the southwest and reaches a maximum average speed of 12 mph during spring (1). The average relative humidity in midafternoon is around 60 percent.

TABLE 2. CLIMATOLOGICAL SUMMARY FOR BLACKFORD COUNTY

For The Period 1980 - 1988				
	Temperature (F)			Average Precipitation
MONTH	MAX	MIN	AVERAGE	(inches)
January	31.2	17.0	24.1	1.37
February	36.9	20.3	28.6	1.98
March	49.0	29.2	39.1	2.77
April	60.9	39.8	50.4	3.09
May	73.1	51.1	62.1	3.31
June	81.2	59.8	70.5	5.00
July	85.8	65.0	75.4	3.45
August	83.5	62.9	73.2	3.22
September	76.9	55.3	66.1	2.31
October	61.5	43.2	52.4	2.68
November	50.9	34.6	42.8	3.61
December	37.1	23.6	30.4	2.77

Table 3. THIRTY YEAR NORMAL CLIMATE DATA

For The Period 1951 - 1980				
	Temperature (F)			Average Precipitation
MONTH	MAX	MIN	AVERAGE	(inches)
January	33.0	17.4	25.2	2.30
February	36.8	19.8	28.3	2.06
March	47.4	28.9	38.2	3.28
April	61.4	39.7	50.6	3.90
May	72.6	49.6	61.1	3.56
June	82.1	58.8	70.5	4.15
July	85.3	62.8	74.0	3.80
August	83.7	60.7	72.2	3.19
September	77.6	54.0	65.8	3.24
October	65.5	42.9	54.2	2.46
November	49.7	33.0	41.4	2.74
December	37.9	23.1	30.5	2.65
Annual	61.1	40.9	51.0	37.33

DRAINAGE FEATURES

Figure 2 is the "Drainage map of Blackford County, Indiana" prepared in 1948 by the staff of the Joint Highway Research Project at Purdue University. As shown in Figure 3, Blackford County lies entirely within the Wabash River watershed of Indiana. The principal stream in Blackford County is the Salamonie River. It enters from Jay County near Blackford County's northeast corner and flows in a northwest direction past Montpelier where it enters Wells County and eventually joins the Wabash River (2).

Northeastern Blackford County is drained by tributaries of the Salamonie River which includes Slocum Ditch and Crooked Creek. The northwest part of Blackford County is drained by Prairie Creek. Most of the southern half of Blackford County is drained by Big Lick Creek and its tributary Little Lick Creek. This drainage system flows in a southwest direction and exits Blackford County at its southwest corner where it joins the Mississinewa River. The central-western part of Blackford County is drained by Walnut Creek (2).

The drainage pattern of the Salamonie stream systems are dendritic. The drainage pattern in the morainic areas are deranged dendritic while the ground moraine areas are broadly dendritic (2). In the poorly drained level parts of the county, ditches have been constructed by dredging to improve drainage. The dredged ditches have modified the drainage patterns in a rectilinear manner.

WATER SUPPLY

Blackford County is located in the Northern Till Plain Groundwater Section Of Indiana as illustrated in Figure 4. The major source of water in Blackford County is groundwater. Much of the groundwater is contained in an aquifer located below 150 feet of glacial till. This aquifer consists of a sand and gravel layer and contains large quantities of water. Wells drilled into the underlying limestones yield water only if cracks or voids in the rock are present (1).

Another major aquifer in Blackford County is the result of a pre-Pleistocene river valley called the Teays Valley. This east-west trending sub-terranean valley is filled with sand and gravel and is located below the glacial till. Wells drilled into this aquifer are around 400 feet deep and yield abundant water. Where needed, surface water from streams is used to supplement the ground water supply.

The water use summary for Blackford County for 1988, a year of drought throughout the Midwest, is shown in Table 4.

TABLE 4 WATER USE SUMMARY FOR BLACKFORD COUNTY (15)
(1988 USAGE IN MILLIONS OF GALLONS)

Month	Source Ground	Surface	Total
January	39.39	18.80	58.19
February	38.44	17.21	55.65
March	43.48	17.94	61.41
April	40.74	17.29	58.03
May	55.05	18.59	73.63
June	59.31	18.80	78.10
July	55.00	18.13	73.13
August	61.00	18.92	79.92
September	50.42	15.09	65.50
October	51.12	8.74	59.86
November	43.32	8.40	51.72
December	42.38	8.68	51.06
Total	579.64	186.58	766.22

PHYSIOGRAPHY

Blackford County lies entirely within the Tipton Till Plain physiographic province of Indiana, as shown in figure 5. In relation to the physiographic provinces of the United States, Blackford County is located in the Till Plains province section of the Central Lowland Province (9).

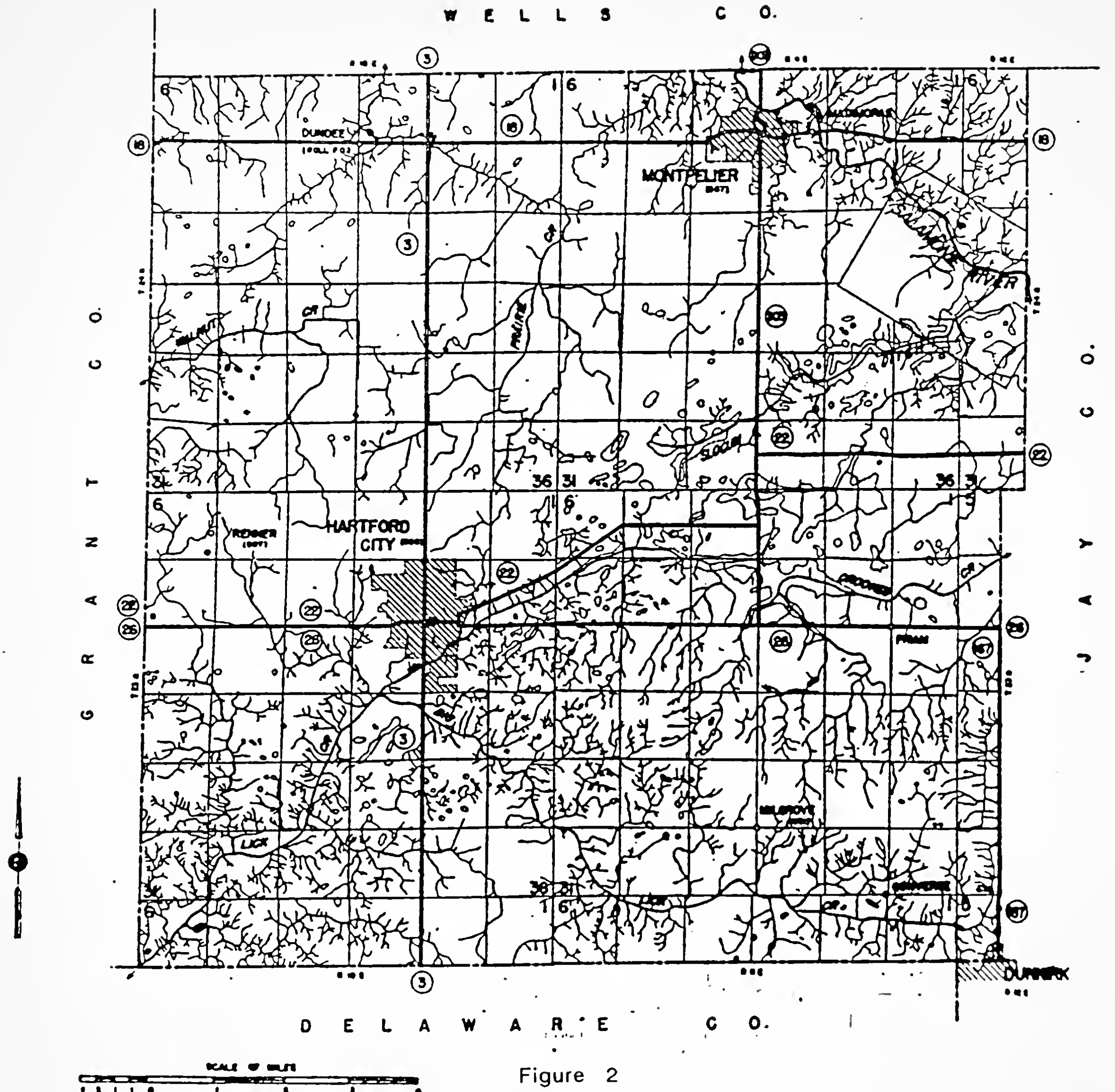


Figure 2

DRAINAGE MAP

BLACKFORD COUNTY

INDIANA

PREPARED FROM

1941 AAA AERIAL PHOTOGRAPHS

BY

STATE HIGHWAY COMMISSION OF INDIANA

AT

PURDUE UNIVERSITY

1948

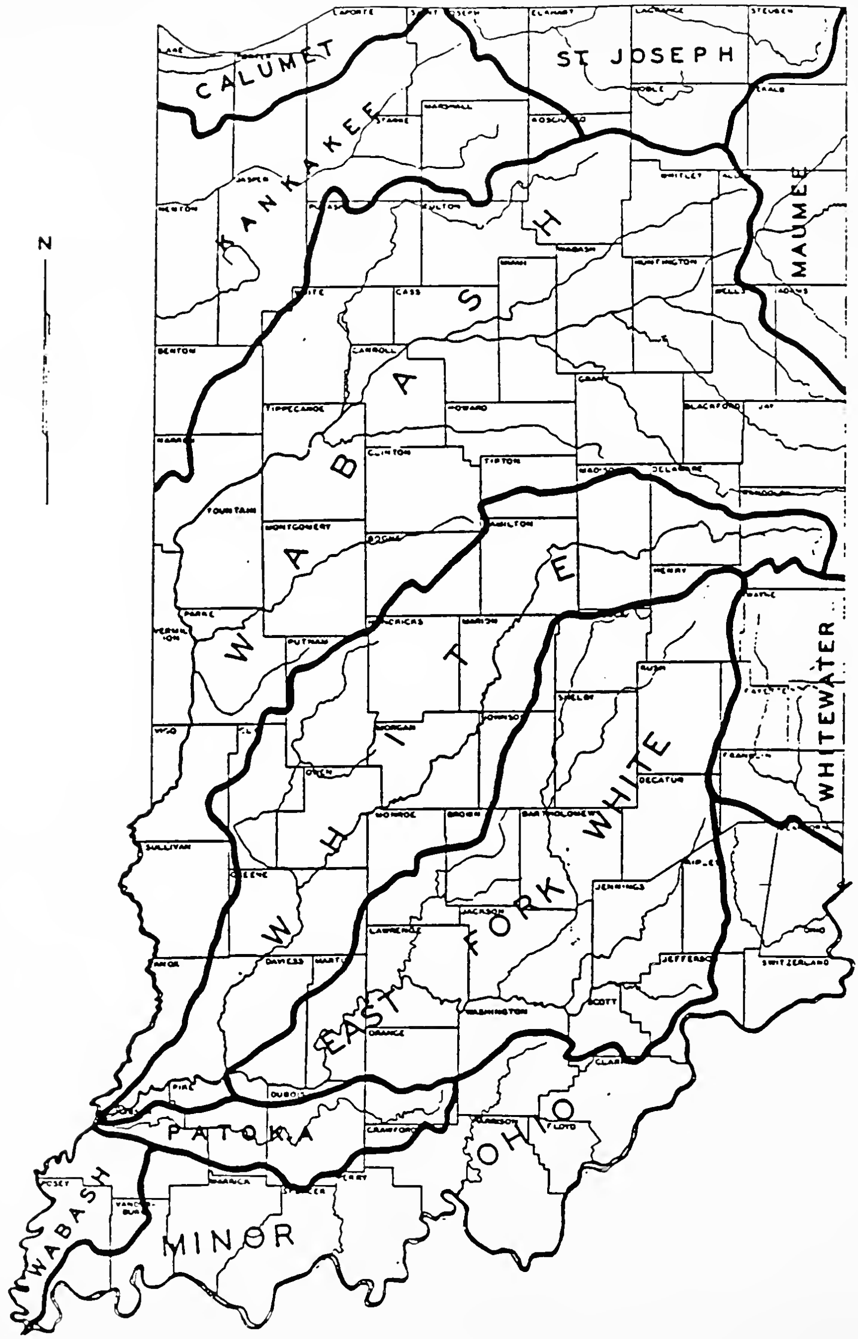


FIGURE 3. MAJOR WATERSHEDS OF INDIANA (4)

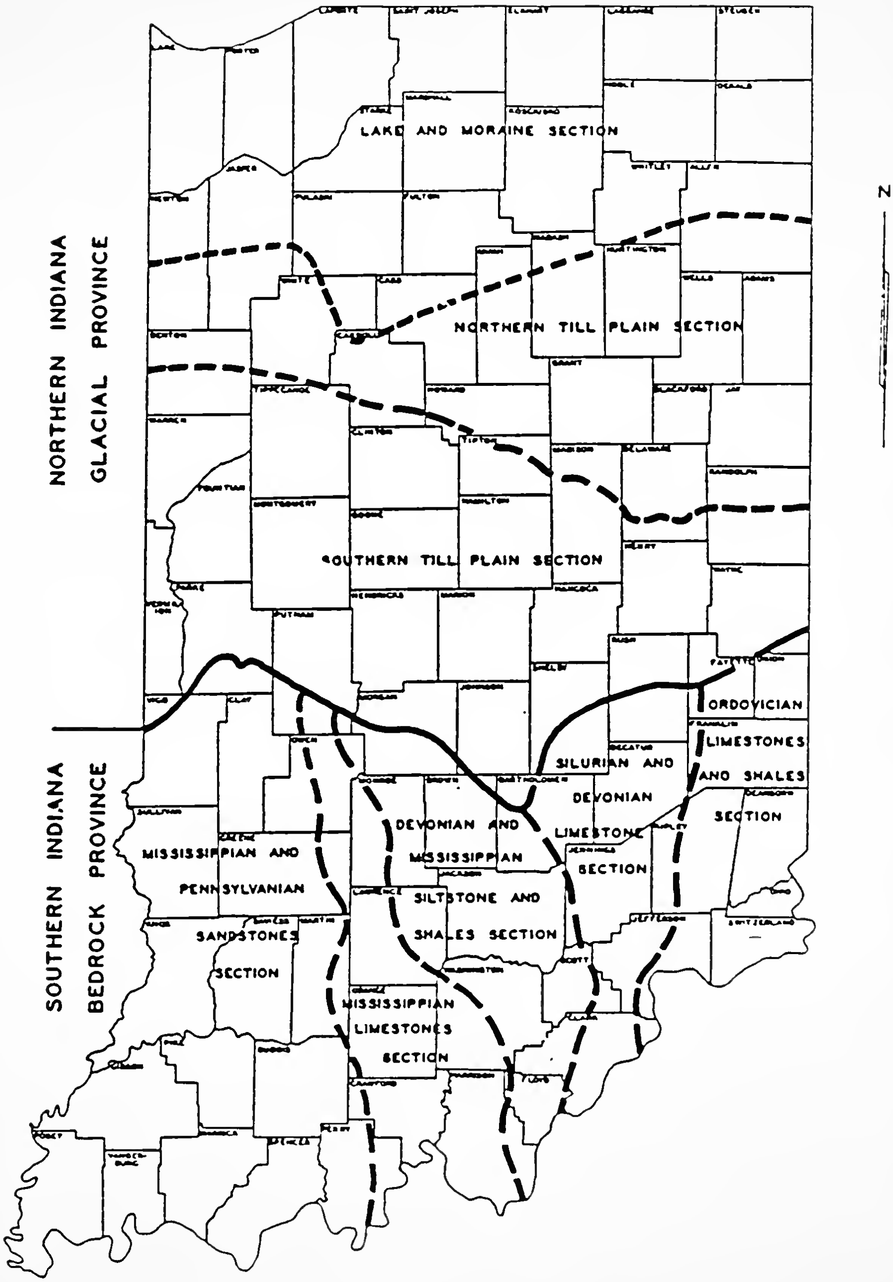


FIGURE 4. GROUNDWATER SECTIONS OF INDIANA (4)

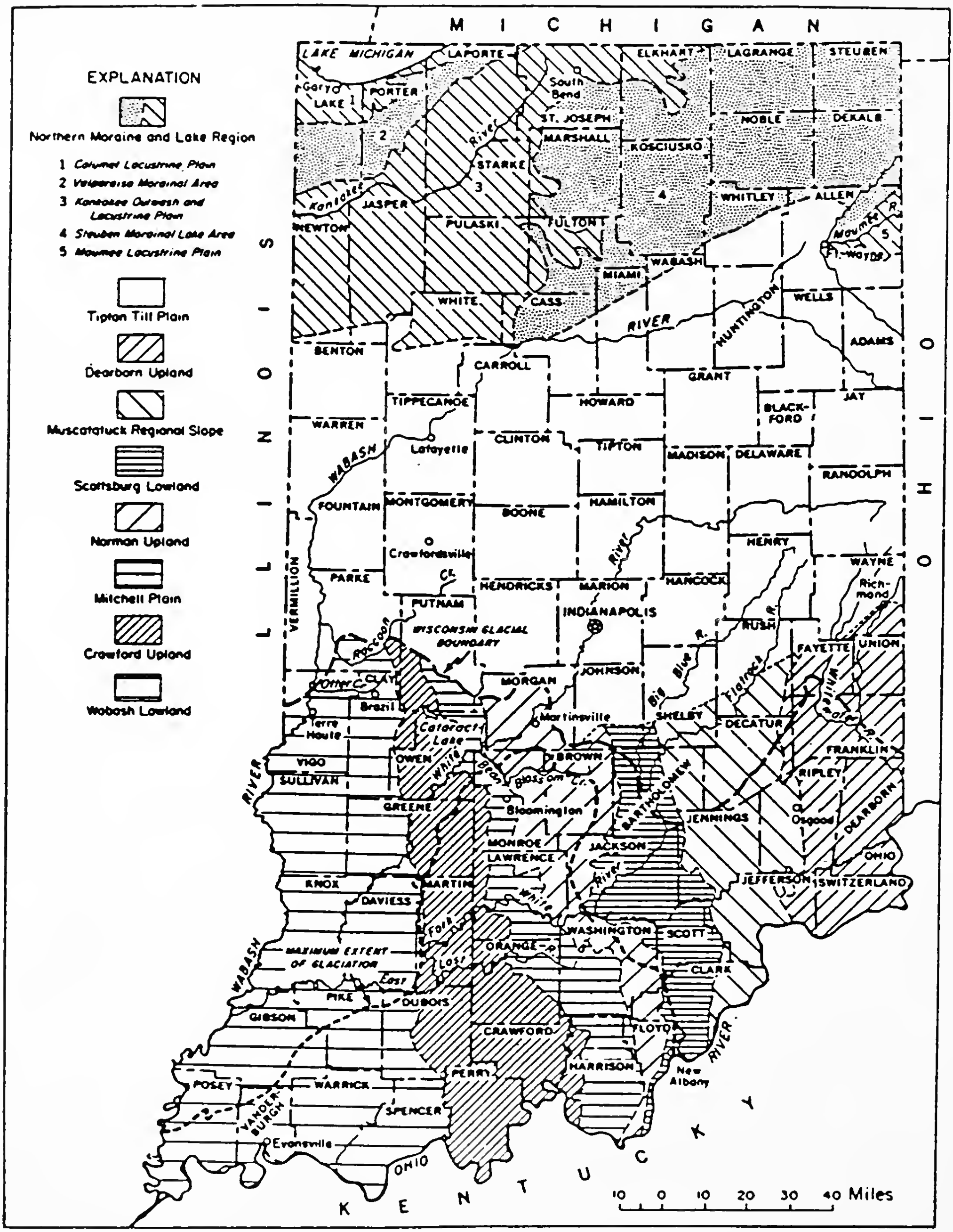


FIGURE 5. PHYSIOGRAPHIC UNITS AND GLACIAL BOUNDARIES IN INDIANA (18)

TOPOGRAPHY

The topography of Blackford County is generally level to slightly undulating, as depicted in figure 6. The nearly level terrain of the ground moraine is entrenched by the Salamonie River, Big Lick Creek and Little Lick Creek and their tributaries. The terrain is more undulating within the Mississinewa and Salamonie ridge moraines that cross the county (2). Local relief in the morainic areas is about 20 to 40 feet. The ridge moraines rise so slowly that the boundary between the ridge and ground moraines is not conspicuous.

The highest point in Blackford County is about 950 feet and the lowest point is about 825 feet above sea level. The maximum local relief is about 60 feet. The center of Hartford City lies at 920 feet above sea level.

GEOLOGY OF BLACKFORD COUNTY

Blackford County lies on the northern flank of the Cincinnati Arch. The Cincinnati Arch is a crestal structural feature which extends from east-central Indiana northwestward to Lake County, Indiana. This structural feature is broad and platformlike and is a few miles in width. In the crestal area of the Cincinnati Arch, the dip is low to intermediate. In the flanks of the arch, the dip increases to 35 feet or more per mile. The Cincinnati Arch is bounded to the north and southwest by the flanks of two large structural depressions, the Michigan and Illinois Basins. These large structural features have had a large influence on the outcrop patterns of Silurian formations in northern and central Indiana.

The surface and near surface geology of Blackford County consists primarily of bedrock of Silurian age (Figure 7) and unconsolidated deposits of Quaternary age. The bedrock in Blackford County is covered by unconsolidated silt, sand, clay, and gravel which were deposited

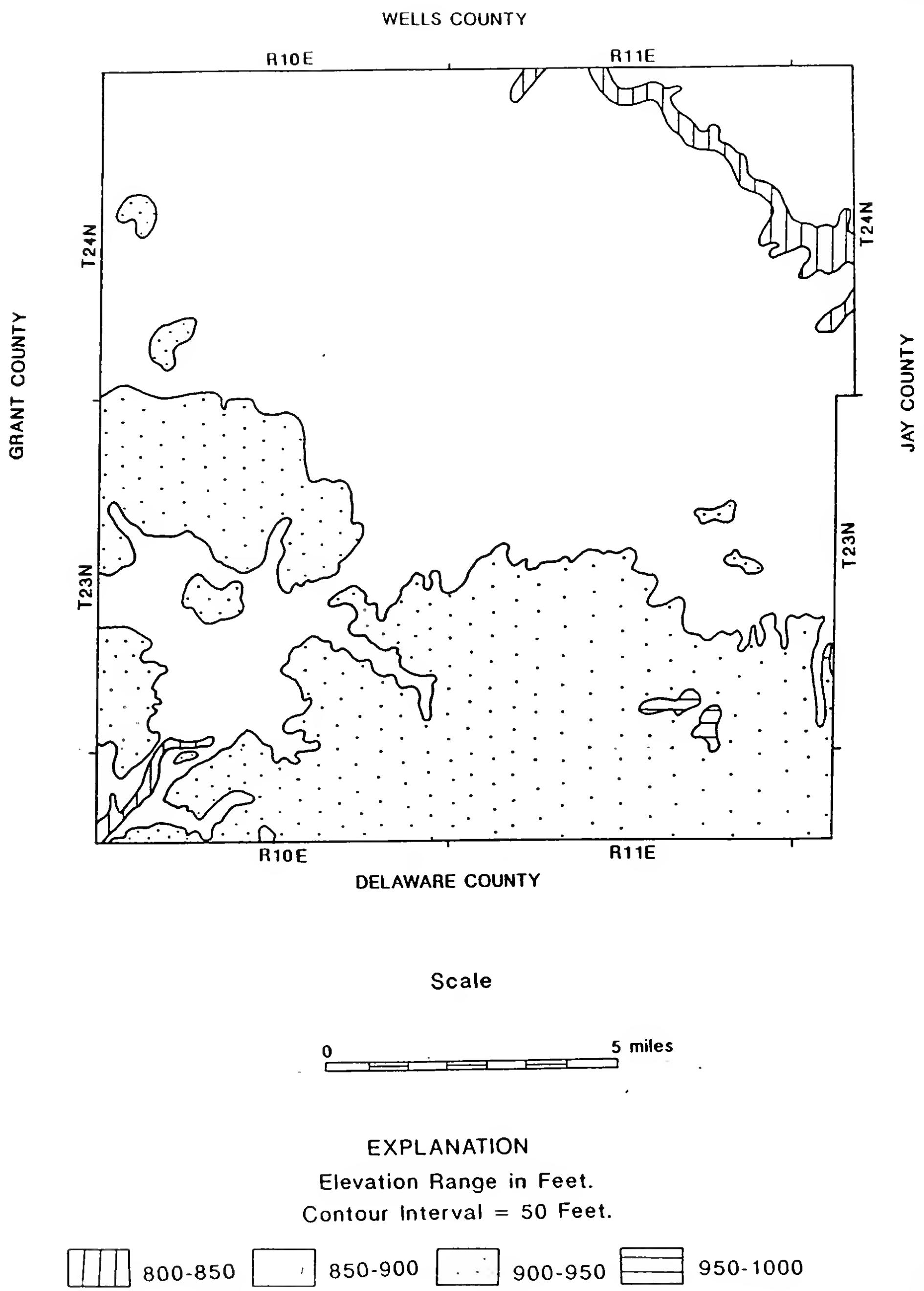


FIGURE 6 TOPOGRAPHIC MAP OF BLACKFORD COUNTY (19)

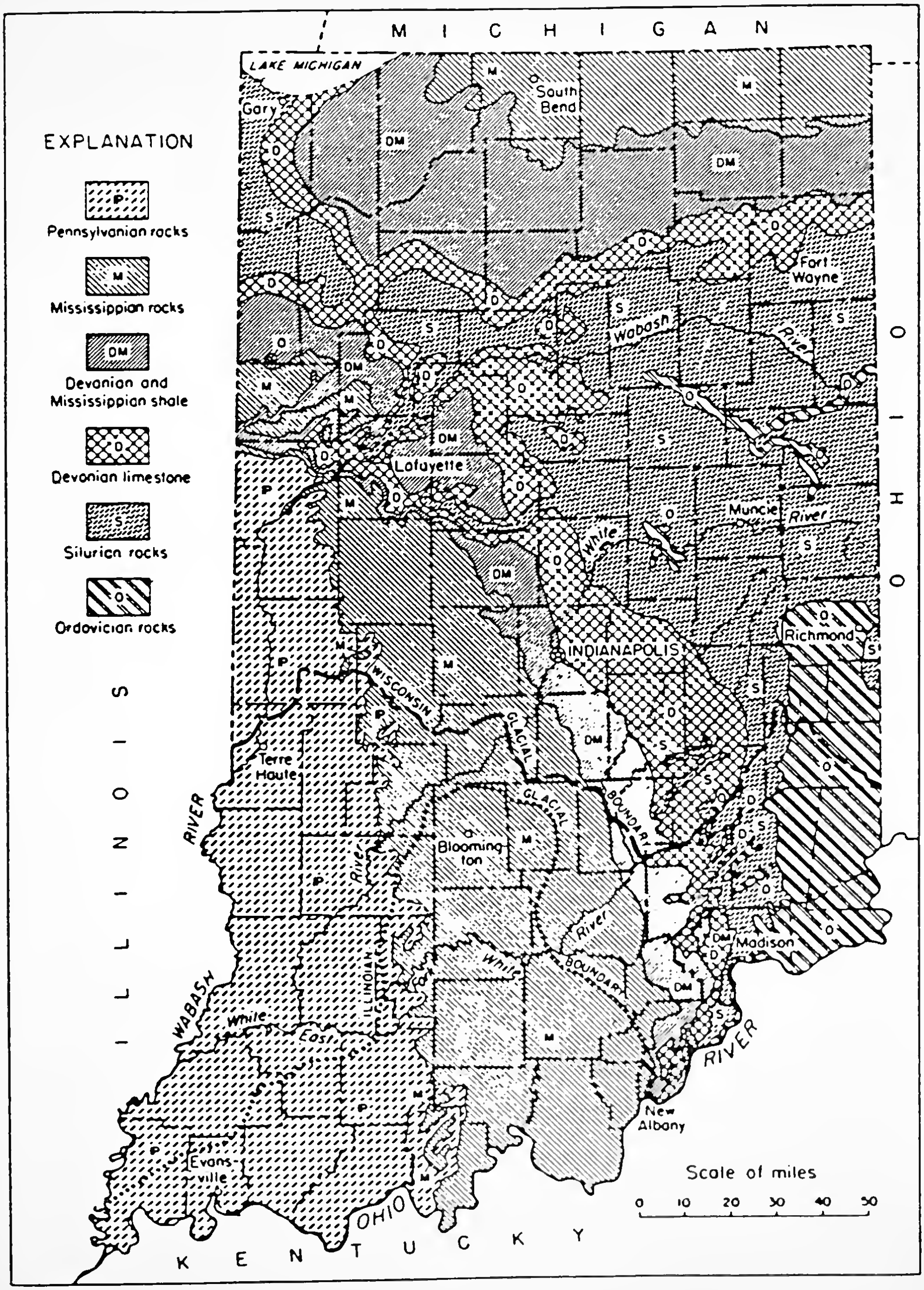


FIGURE 7. BEDROCK GEOLOGY OF INDIANA (20)

by continental glaciers during Pleistocene time. The glacial drift in Blackford County varies in depth from two feet along the Salamonie River near Montpelier to more than 450 feet along the buried Teays river valley (34). The glacial deposits along the flood plains of the Salamonie River, Big Lick Creek and Little Creek, and their tributaries are overlain by thin alluvial deposits of Recent age.

The bedrock underlying the glacial drift consists of about 400 feet of dolomite, dolomitic limestone, limestone, and shale of middle Silurian age. The Silurian rocks are underlain by about 600 feet of blue calcareous shales and thin-bedded impure limestones of Ordovician age and at greater depths by Cambrian rocks.

BEDROCK GEOLOGY

Blackford County is underlain by rocks of Ordovician and Silurian age. The bedrock geology of Blackford County is shown in Figure 8.

In eastern Indiana, the uppermost Ordovician rocks are characterized by light- to dark-colored mottled fine- to coarse-grained fossil-fragmental limestone and dolomitic limestone that is interbedded with or has intercalations of gray-green calcareous shale and green fine-grained argillaceous dolomite (6). All of the uppermost Ordovician rocks in eastern Indiana are generally assigned to the Richmond Group of the Cincinnatian Series.

Rocks of Ordovician age are encountered at depths around 900 to 1000 or more feet in Blackford County. Many wells were drilled into the Trenton Limestone for oil and gas (5). The Trenton limestone is overlain by several feet of Ordovician shale. The Ordovician shales are overlain by the Silurian rocks except where a pre-Pleistocene valley has cut into the uppermost part of the Ordovician shales.

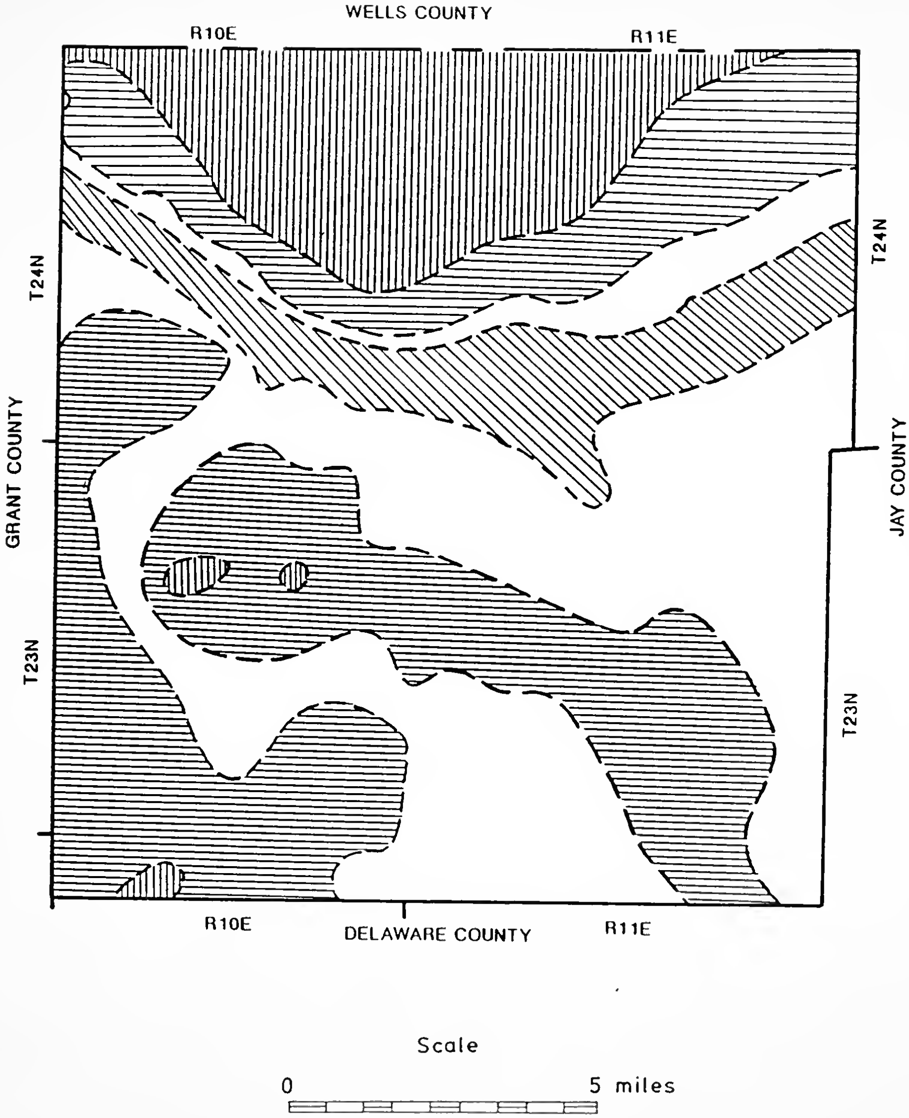


FIGURE 8 BEDROCK GEOLOGY OF BLACKFORD COUNTY (23)

The boundary between Ordovician and Silurian rocks is marked by an unconformity which is often difficult to recognize in rock borings. Overlying the Ordovician rocks is the Brassfield Limestone (7). The Brassfield Limestone is the lowermost rock unit of Middle Silurian age as rocks of Early Silurian age have not been identified in Blackford County. This unit has an average thickness of 12 feet; although, the Brassfield equivalent, located in the northeast corner of Indiana as part of the Cataract Formation, is as much as 200 feet thick. The Brassfield Limestone of northern Indiana is generally a medium- to coarse-grained fossiliferous limestone with many thin irregular beds of shale scattered throughout (6). Small amounts of fine-grained dolomite and chert can also be found. The color of the Brassfield Limestone ranges from yellowish-brown to gray-green.

The Salamonie Dolomite overlies the Brassfield Limestone and is a blanketlike deposit of carbonate rock which covered nearly all of Indiana before being partially eroded in post-Silurian time (7). Rocks now considered as part of the Salamonie Dolomite in east-central Indiana have been referred to in earlier literature as the Huntington Dolomite and the New Corydon Limestone. The thickness of the Salamonie Dolomite ranges from zero to 200 feet in far northeastern Indiana.

The Salamonie Dolomite can be divided into two members that have considerable lateral continuity in northern Indiana. The lower member is a light-gray and tan dense- to fine-grained argillaceous impure dolomite and dolomitic limestone. Chert is abundant and is the most characteristic aspect of the lower member (7).

The upper member of the Salamonie Dolomite consists of whitish coarser-grained bioclastic dolomite of high purity. This high-purity dolomite is often referred to as reef-type dolomite in subsurface studies (6).

Overlying the Salamonie Dolomite is the Pleasant Mills Formation. This formation consists of three members: the Limberlost Dolomite Member, the Waldron Member, and the Louisville Limestone Member. The Pleasant Mills Formation belongs to the Salina Group of Silurian age (7).

The Limberlost Dolomite Member ranges from 0 to 70 feet in thickness and consists of brown or tan very fine- to medium-grained generally pure dolomite. It appears massive in cored sections and roughly bedded in weathered exposures (6). In previous literature, the Limberlost Dolomite member was referred to as the Limberlost Dolomite Formation. It was later reclassified as a member of the Pleasant Mills Formation (8).

The middle member of the Pleasant Mills Formation, the Waldron Member, is a shale containing silt and fossiliferous limestone beds that are reeflike in many places. The Waldron Member ranges in thickness from one to 20 feet in northern Indiana (7).

The Louisville Limestone Member, the upper member of the Pleasant Mills Formation, is a light brown colored fine-grained thick-bedded argillaceous limestone and dolomitic limestone (6). The Louisville Limestone Member normally ranges from 40 to 75 feet in thickness.

The Wabash Formation is an extensive body of rock which overlies the Pleasant Mills Formation. The Wabash Formation consists of two members: the Mississinewa Shale Member, and the Liston Creek Limestone Member (7). The Mississinewa Shale Member consists of gray fine-grained argillaceous silty dolomite and dolomitic limestone. The Liston Creek Limestone Member consists of light-gray and tan fine- to medium- grained fossil-fragmental cherty limestone and dolomitic limestone (6). Nodular and bedded chert is the most characteristic aspect of the Liston Creek Member.

EXPLANATION

Silurian	Wabash Formation - Limestone, Dolomite, and Argillaceous Dolomite
	Pleasant Mills Formation - Dolomite, Limestone, and Argillaceous Dolomite
	Salamonie Dolomite, Cataract Formation, and Brassfield Limestone
Ordovician	Ordovician Rocks - Undifferentiated Shale and Limestone

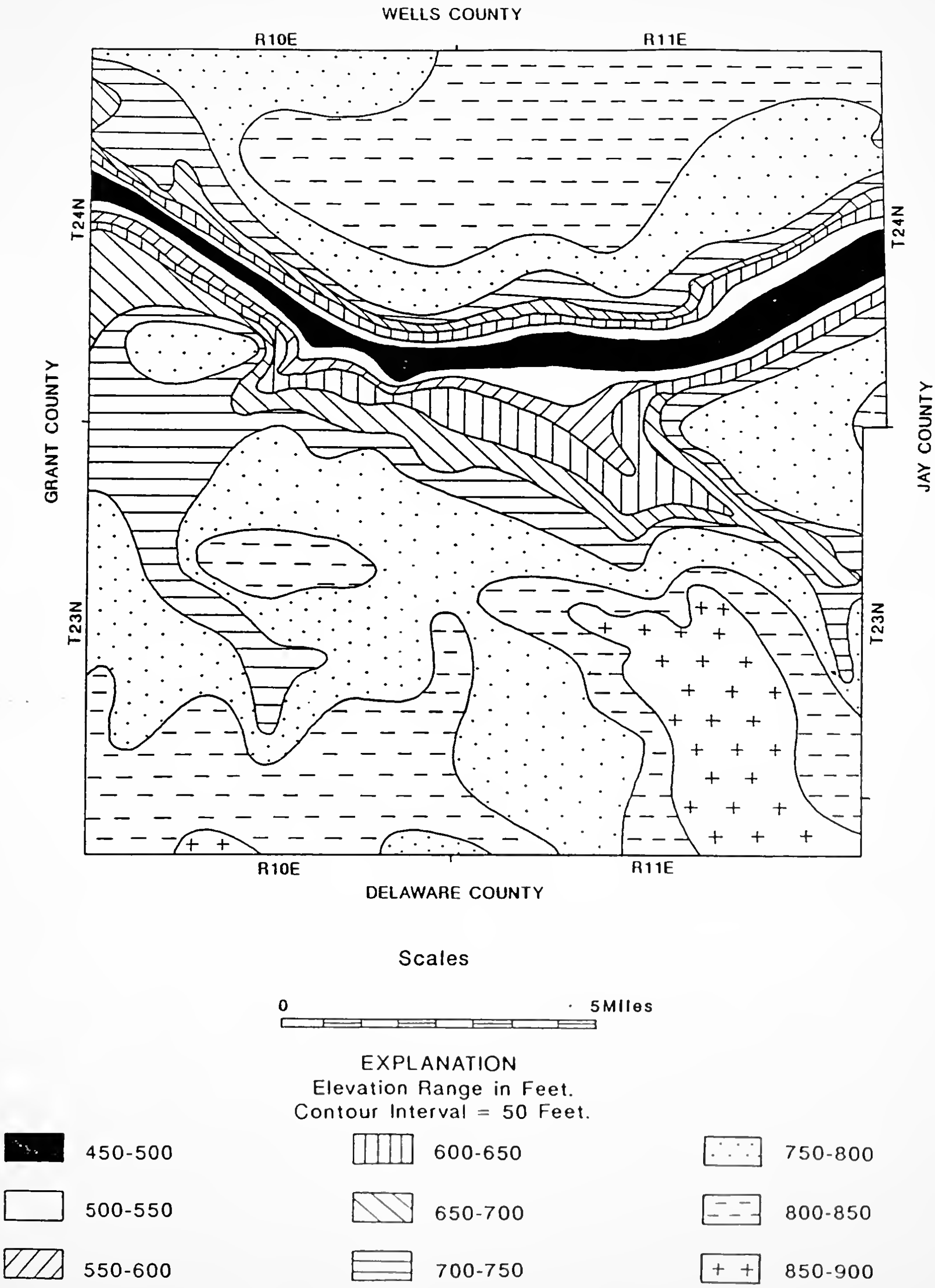


FIGURE 9 BEDROCK TOPOGRAPHY OF BLACKFORD COUNTY (22)

The thick sequences of Silurian limestone and dolomite in northern Indiana slope gently to the north in east-central Indiana and form a nearly flat carbonate upland, known as the Bluffton Plain. The dip of the upland corresponds to the regional dip of the north slope of the Cincinnati Arch. Figure 9 illustrates the general bedrock topography of Blackford County. The highest bedrock elevation is more than 850 feet above mean sea level and is located in the southern and northern portions of the county. The lowest bedrock elevation is around 470 feet above mean sea level and is located in the central part of Blackford County (22).

A pre-glacial southward-flowing stream system was deeply entrenched in the Bluffton Plain. In Blackford County, valley walls up to 420 feet deep were cut into the bedrock plain. This entrenched drainage system is known as the Teays Valley and trends east-west across the central portion of Blackford County (34). Across the Bluffton Plain, the Teays Valley is a nearly vertical walled chasm about two miles wide and is completely filled by Quaternary glacial outwash and non-glacial alluvium (9). The deep Teays Valley probably formed because the massive dolomites and limestones found in the present day valley walls were more resistant to erosion than the shales which presently occur under the glacial outwash material in the center of the valley.

PLEISTOCENE GEOLOGY

The surficial geology of Blackford County consists of unconsolidated glacial deposits of Pleistocene age and alluvium of Recent age. The glacial deposits, which consist of mixtures of silt, sand, clay, and gravel, were deposited by the several continental glaciers which covered northern Indiana in Pleistocene time (9).

Only glacial deposits of Wisconsinan age, the most recent glacial period, are recognized at the surface. These glacial deposits may overlie glacial deposits of Illinoian and Kansan age

whose presence is uncertain. Wisconsinan deposits include ridge and ground moraine, outwash plain and lacustrine plain deposits. The Wisconsinan glacial drift on the preglacial bedrock plains ranges from two to 150 feet in depth. Depressions in the bedrock surface as a result of the Teays Valley are filled with up to 450 feet of unconsolidated glacial deposits (9).

The flat topography in Blackford County today is primarily the result of glaciation although the underlying and relatively flat bedrock surface has probably had some influence. The flat to gently undulating plain is broken by two low ridge moraines: the Mississinewa ridge moraine, and the Salamonie ridge moraine. The Mississinewa Moraine crosses the southwest corner of the county in a northwest-southeast direction. The Salamonie Moraine crosses Blackford County's northeast corner and is roughly parallel to the Mississinewa moraine (2).

The deposits of Recent age in Blackford County consists primarily of alluvium of the flood plains of the Salamonie River, Big Lick Creek, Little Lick Creek, and their tributaries.

The distribution of unconsolidated deposits in Blackford County is shown in Figure 10. As seen on this figure, the unconsolidated deposits occur mainly in the form of Wisconsinan ground and ridge moraines. These deposits consist mainly of till, a poorly sorted silty clay with some sand and gravel.

Late Wisconsinan and Recent unconsolidated deposits are composed primarily of clay, silt, sand, muck, and gravel, whose distribution corresponds to the course of major streams in the county. The variable thickness of unconsolidated deposits is shown in Figure 11. A schematic representation of the relationships between the unconsolidated deposits in Blackford County is shown in Figure 12. Basins of cumulose drift in the form of muck and peat exist in a few locations on the ground moraine and within the ridge moraine.

EXPLANATION

Recent	Silt,Sand,and Gravel - Mostly Alluvium, Martinsville Formation
Recent and Wisconsinan	Muck, Peat, and Marl - Paludal and Lacustrian Deposits. Martinsville Formation
	Muck, Clay, Silt and Gravel - Alluvial, Colluvial, and Paludal Deposits
	Clay, Silt, and Sand - Clay-rich Lacustrian Facies of Atherton Formation
	Gravel, Sand, and Silt - Valley Train Deposits. Outwash Facies of Atherton Formation
Wisconsinan	Till - Wisconsinan Ground Moraine
	Till - Wisconsinan End Moraine
Ordovician	Rocks of Late Ordovician Age - Shale and Limestone

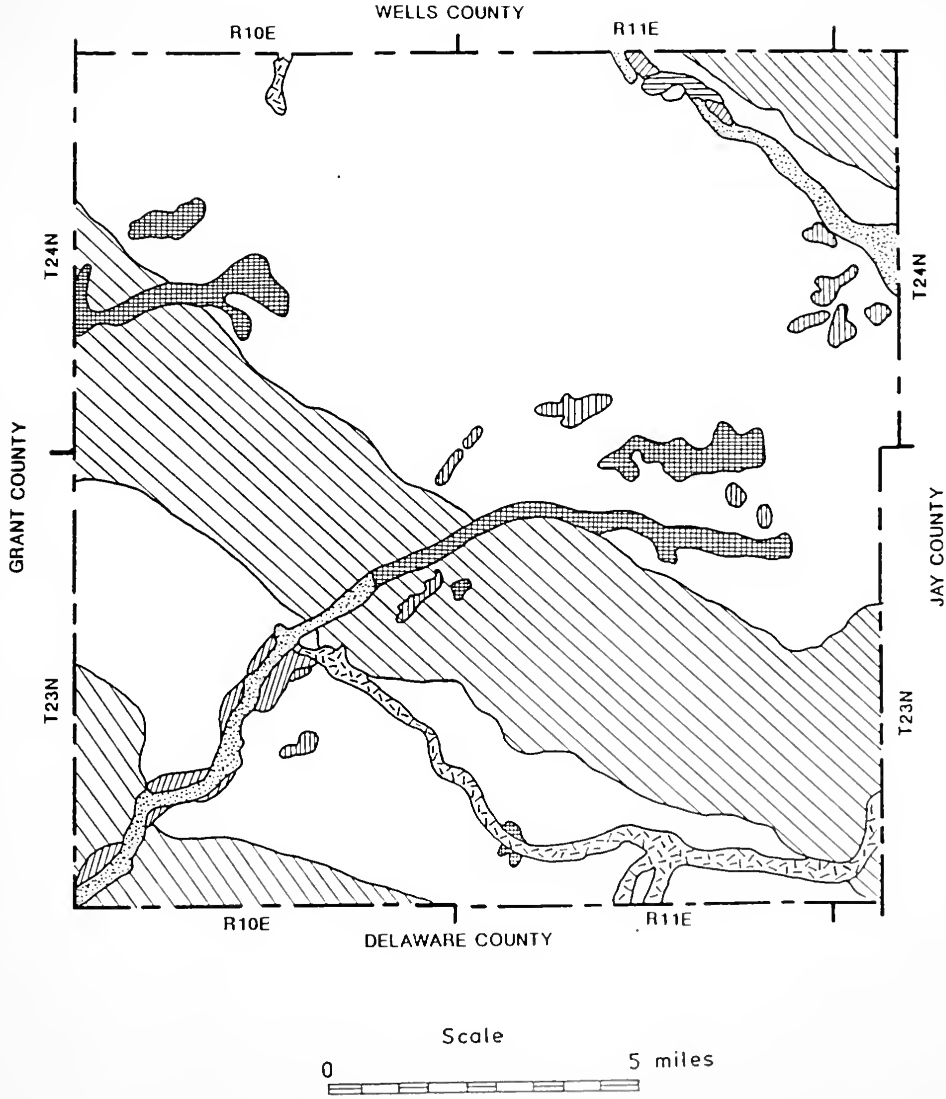


FIGURE 10 UNCONSOLIDATED DEPOSITS OF BLACKFORD COUNTY (23)

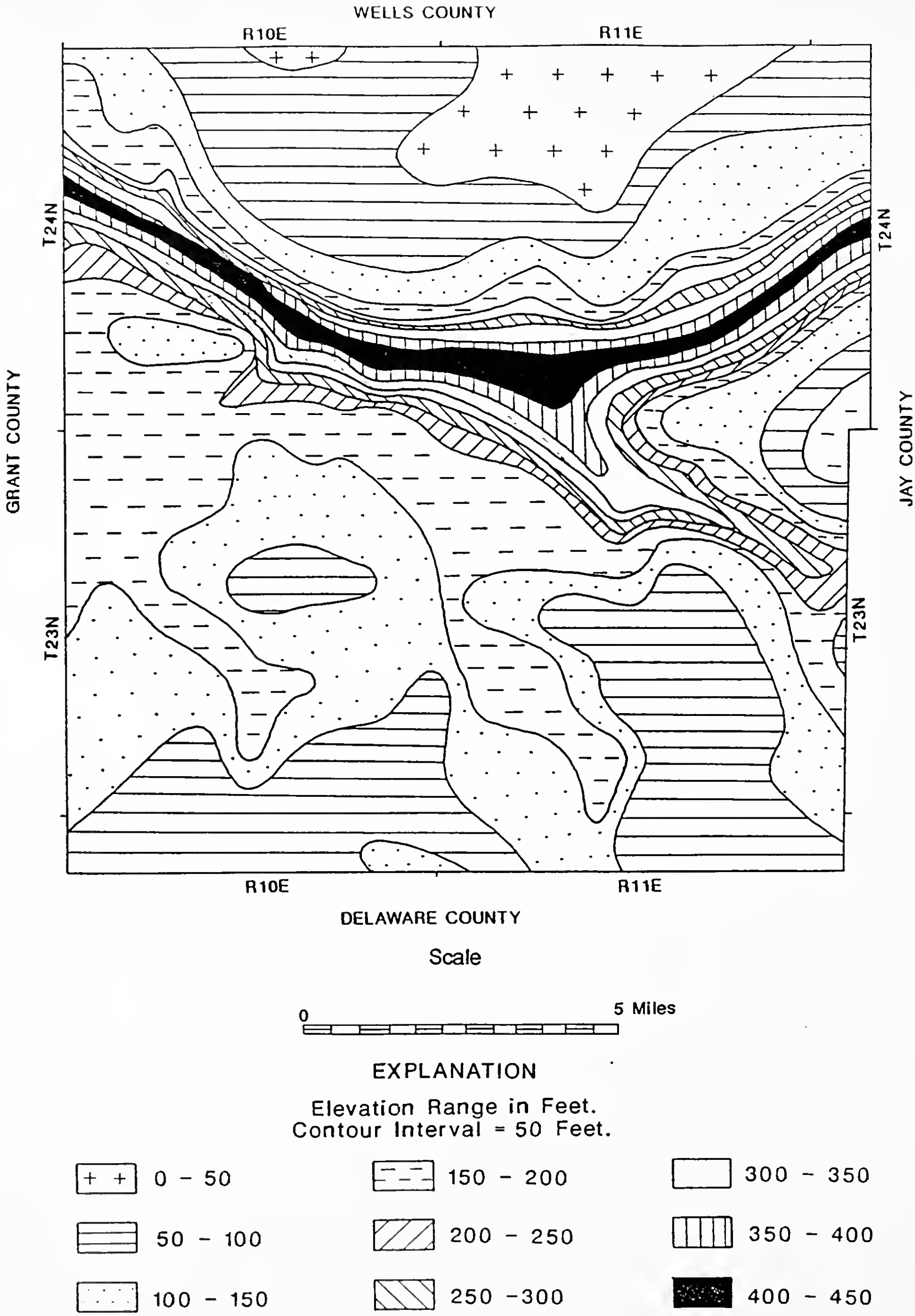
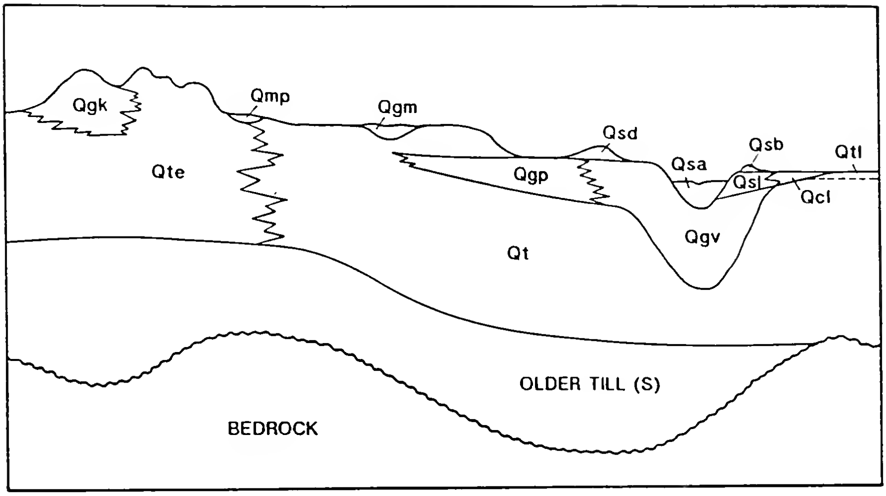


FIGURE 11 THICKNESS UNCONSOLIDATED DEPOSITS (24)



EXPLANATION

Quaternary

Qsa	Silt, sand, and gravel
Qmp	Muck, peat, and marl
Qgm	Muck, clay, silt, and gravel
Qcl/Qsl	Clay, silt, and sand
Qsd/Qsb	Sand
Qgv/Qgp	Gravel, sand, and silt
Qgk	Gravel and sand
Qt/Qte	Till

FIGURE 12. SCHEMATIC SECTION SHOWING RELATIONSHIPS OF UNCONSOLIDATED DEPOSITS (24)

LANDFORM-PARENT MATERIAL REGIONS

The soils in Blackford County were derived primarily from unconsolidated materials. These materials are classified according to landform and parent material in the following section. Five parent material units have been mapped in Blackford County. These are glacial drift, fluvial drift, lacustrine drift, cumulose drift, and mined land. The parent materials are further divided into individual landforms for discussion purposes.

Each landform-parent material region is characterized by its overall extent, surface character, and general soil profile. Soils have been classified using both the United States Department of Agricultural (USDA) textural designation, i.e. clay loam, and also the American Association of State Highway Officials (AASHTO) system, i.e A-4. In addition, the agricultural soil series that occur in each landform unit has been identified. The physical, chemical, and engineering index properties of the soils in Blackford County are given in Appendices B and C. Boring numbers, which correlate to the classification test results listed in Appendix A, are given for each corresponding soil unit.

Engineering considerations are discussed for each parent material region. The objective of this discussion is to provide a general idea of soil behavior and of the possible problems that may occur within a given landform-parent material region in Blackford County.

GLACIAL DRIFT

Glacial landforms occupy approximately 95% of the parent material accumulations in Blackford County. The types of glacial landforms present are Wisconsinan ridge moraine and ground moraine.

Ridge Moraine

Two morainic systems are present in Blackford County. They are the Mississinewa Moraine and the Salamonie Moraine. The nearly parallel ridge moraines are separated by a level plain of Wisconsinan ground moraine.

The Mississinewa ridge moraine is oriented in a northwest to southeast direction and crosses the southeast corner of the county. Hartford City lies near the intersection of an inner and outer ridge of the Mississinewa ridge moraine. The outer ridge closely follows the Mississinewa River to the south and is one to two miles wide. The northern inner ridge is three to five miles wide. Local relief of the inner and outer ridge moraines ranges from 20 to 40 feet (2). The inner and outer ridge moraines are separated by a level strip of glacial till which ranges from one to four miles in width.

The Salamonie ridge moraine crosses the northeast corner of Blackford County and is roughly parallel to the Mississinewa ridge moraine. The Salamonie ridge moraine is bounded to the south by the Salamonie River and is an average of two miles wide.

The regional drainage pattern of ridge moraines is deranged dendritic and poorly developed. Artificial drainage systems, tiles or ditches, have been constructed to improve drainage. The gullies on ridge moraines are usually broad saucer shaped C-type with extremely long low gradients (13). The mottled light and dark photo tones associated with Wisconsinan ridge moraines indicate the presence of fine-grained materials. The parent material on ridge moraines is unsorted silt, sand, clay, gravel, and boulders. Layers of stratified sand and silty sand may also be found within the unsorted material (13).

The soil profiles for the Wisconsinan ridge moraine in Blackford County were divided into two categories. The categories are high and low areas on ridge moraine and they represent the general subsoil conditions of the high and low areas of the Wisconsinan ridge moraines.

The soil developed in the high areas of ridge moraine in Blackford County include the Blount, Glynwood, and Morley pedological series (1). These soil series are characterized by a silty loam (A-4, A-6) surface soil which extends to a depth of about nine inches. Underlying the surface soil to a depth of about 48 inches is clay loam, silty clay, and sandy clay loam (A-4, A-6, A-7).

The dominant soils developed in the low areas of ridge moraine include the Pewamo, and Wakill Variant. Isolated areas of the Houghton (organic) soil series are found in the deeper depressions of ridge moraine (1). The Houghton soils are deposits of shallow water lacustrine sediments and organic matter and are discussed further under Cumulose Drift. The surface soils of the low area of ridge moraine are characterized by organic silty clay and loam (A-4, A-6, A-7) to a depth of 10 inches. The surface soils are underlain by clay loam (A-6), loam (A-4, A-6), sandy loam (A-2-4, A-2) and clay(A-7).

Borehole numbers 28-41 are located on ridge moraines in Blackford County.

Ground Moraine

Wisconsinan ground moraine deposits cover a large area of Blackford County. Ground moraines have a gently undulating topography and are characterized by shallow swales and low swells.

The regional drainage pattern of ground moraines is broadly dendritic. Gullies on ground moraines are usually of the C-type where clay and silty clay occur. In areas where considerable amounts of sand and gravel occur, V-type gullies are present (13).

The high areas on ground moraines usually display a light-gray to white photo tone indicating silty soils. The low areas on ground moraines display a dark-gray to black photo tone indicating soils having high organic contents. The parent material of ground moraines is an

assorted mixture of gravel, silt, sand, and clay, with a few boulders (13). In general, nearly all of the soils located on Wisconsinan ground moraines in Indiana can be classified as silty clays.

The soils which developed on both the ridge and ground moraines in Blackford County are similar in nature. The surface soils generally consist of clay loam (A-6) and silt loam (A-4). Highly organic topsoil occurs in the depressions on ground moraines. The subsurface soils, below a depth of 24 inches, generally consist of silty loam (A-4), clay (A-7), and silty clay loam (A-6). The agricultural soils that have formed on ground moraine are Blount, Glynwood, and Martinsville pedological series.

Highly organic topsoil is found in depressions on both ground and ridge moraines throughout Blackford County. Highly organic topsoil is represented by the Pewamo, Wakill Variant, and Houghton soil series. The organic content of the surface soils ranges from 4 to 70 percent or more. The soils which underlie the highly organic topsoil consists primarily of silty clay loam (A-6, A-7).

Engineering Consideration in Glacial Drift

The soils in glacial drift areas of Blackford county are moderately plastic with plasticity indices ranging from seven to 40 and liquid limits ranging from 25 to 60. These soils are cohesive and range in consistency from soft to stiff. The permeability of the soils in the glacial drift area is low. As a result, these areas are subject to ponding, slow runoff, and have a high shrink-swell and frost action potential.

Numerous road and highway problems occur in glacial drift areas. Some of the common problems encountered in the highly organic glacial drift areas are pavement pumping, frost heave, erosion of slopes, and poor drainage. Pavement pumping occurs when water carrying soil particles is forced out between pavement joints or cracks under normal traffic loads (17).

The resulting cavity under the pavement causes cracking and settling of the slab. Roads should be constructed on elevated, well-compacted fill to reduce problems in clay-rich and silty-clay soils (11). To avoid ponding and frost heaving, drainage ditches or culverts should be installed during construction in the glacial drift areas.

The bearing capacity of soils in glacial drift ranges from low to fair. Slope failure is possible where water-bearing layers of permeable material are present. Glacial drift areas are extremely limited as sites for streets or highways due to their low strength, and high shrink-swell and frost action potential. These areas are limited as sites and septic fields due to the low permeability and poor drainage (33). The ground moraines with depths of glacial drift greater than 30 feet are potential sites for engineered landfills with minimal damage to the environment. A detailed site investigation should be performed whenever a large or heavy structure is to be constructed on glacial drift.

FLUVIAL DRIFT

Fluvial drift occurs in two separate landforms in Blackford County: along the flood plains of rivers and their tributaries, and on the terraces along the rivers.

Flood Plains

The largest flood plain areas in Blackford County are along the major rivers and creeks: the Salamonie River, Big Lick Creek, and Little Lick Creek. The pedological soil series which are developed on flood plains in Blackford County include the Eel, Eel Variant, Eldean, Saranac, and Wakill soils (1). Flood plain soils are characterized by 12 inches of surface soil which consists of silty loam (A-4, A-6), and, in limited areas, organic silty clay. The surface soil is underlain by sandy clay loam (A-6, A-7) and loam to a depth of 40 inches or more. At depths greater than 50 to 60 inches, the flood plain soils are silty clay loam, gravelly sandy loam, and

stratified silty clay loam (A-6(9)) to sandy loam. Limestone bedrock also can be encountered at depths as low as 24 inches below the surface in flood plain areas.

Borehole numbers 1-27 are located on flood plains.

River Terrace

Recent river terraces are found along Big Lick Creek, the Salamonie River, and their associated tributaries in Blackford County. Material for the river terraces comes from recently eroded sediments and reworked outwash sand and gravels of the glacial epoch. The river terraces are composed of mainly stratified deposits of silt, sand, and gravel with some clay. The major soil types which occur in river terraces in Blackford County are the Eldean, Martinsville, and Whitaker soil series. The surface soils of the river terraces consist of clay loam, silty loam, and loam. The surface soils are underlain by gravelly sandy loam, and stratified sandy clay loam to a depth of 48 inches. Underlying these soils are stratified sand and gravel (A-1, A-2) and stratified silt loam to sand (A-2, A-4, A-6).

Engineering Considerations in Fluvial Drift

The soils on flood plains are slightly to moderately plastic with plasticity indices ranging from three to 35 and liquid limits ranging from 24 to 65.

Due to depositional processes, the soils in flood plains are highly variable over distance and depth with the soil ranging from loose sands to weak compressible clays. This variability of soils can cause foundation problems as a result of non-uniform strength. Flood plains are extremely limited as sites for roads or highways due to their low strength, and high shrink-swell potential, frost action potential, and potential for seasonal flooding (33).

The groundwater table in these soils is high and ponding and surface flooding is frequent. Because of the flooding and general wetness, the flood plain areas are poorly suited for dwelling and septic tank fields (33).

The river terrace soils in Blackford County are incohesive and non-plastic with plasticity indices ranging from 2 to 15 and liquid limits ranging from 15 to 40. The soils in these areas generally have a moderately high permeability and a high porosity. The water table in the terrace areas is high so that the low areas are subject to flooding. The bearing capacity of the terrace soils ranges from fair to good. Also, the deposits in the terraces can be used as a commercial source of sand and gravel (13).

In areas where there is a high silt content, frost action and shrink-swell potential is high (33). This limits the terrace soils as potential sites for roads and streets. Slope failure in cuts made in terraces is also possible due to the seepage of water.

The moderately high permeability of the terrace soils makes them impractical as sites for land fills or septic tanks since the rapid drainage can result in groundwater contamination (1).

LACUSTRINE DRIFT

Lacustrine Plains

There are a large number of lacustrine plains present in Blackford County. These plains are widely scattered, lack beach ridges, and range from a few acres to over one square mile in area. In general, lacustrine drift consists of fine-grained materials.

Pedologically, the soils which occur on lacustrine plains in Blackford County are the Bono and Bono Variant soil series (1). The surface soils of the lacustrine plains are characterized by organic silty clay loam and muck. The organic content of these soils ranges from four to 31 percent. Below 10 inches, the lacustrine plains consist primarily of silty clay and silty clay loam (A-7) that may occasionally have thin seams of sand.

Engineering Considerations in Lacustrine Drift

The lacustrine deposits are moderately plastic with plasticity indices ranging from 20 to 44 and liquid limits ranging from 40 to 65.

These deposits have a low permeability and are subject to flooding or ponding due to a high water table. Drainage of these soils is poor. As a result, these soils have a high potential for frost damage (33).

The compaction characteristics of the lacustrine soils ranges from poor to fair. They also have low strength and a high shrink-swell potential which reduces the bearing capacity of these soils. Failure of cut slopes is not uncommon in the lacustrine soils due to the presence of thin seams of sand which act as planes of weakness. Roads constructed on these soils should be built on raised, well-compacted fill material with side ditches and culverts to improve roadside drainage (17). In addition,the roads should be placed on quality base material to increase their load capacity and decrease the potential for frost damage (1). The low permeability and high water table makes the lacustrine soils generally unsuitable for the sites of septic tank and tile fields (33).

CUMULOSE DRIFT

Muck Basin

Deposits of muck and peat are found in Blackford County in kettle-like depressions on lacustrine plains, flood plains, ground and ridge moraines. Most of the muck basins mapped are small in size; however, some larger deposits occur in the central part of the county. Muck basins usually have a very dark photo tone and are characterized by flat topography and the absence of natural drainage (13).

The major soil series found in muck deposits in Blackford County is the Houghton soil series (1). This soil series is characterized by primarily a highly organic silty clay surface soil

to a depth of 50 inches. The organic content can be greater than 70 percent. Other surface soils found in muck basins include silty clay loam, clay, silty loam, and marl(A-8). Underlying the surface soils are silt, sandy clay loam, marl, and gravelly sandy loam.

Engineering Considerations in Cumulose Drift

The soils found in cumulose drift are characterized by a very high organic content, low density, and a high natural water content. The permeability and porosity of cumulose drift in Blackford County are high. These soils have a soft to very soft consistency and are compressible. The high compressibility and low shear strength of cumulose drift makes it unsuitable for fill or foundation material, or as sites for roads and streets. Normally, these soils are avoided during construction as they require special foundations and special fills. However, if this is not possible, removal of the cumulose drift may be needed. Preloading can also be used to improve the bearing capacity of these soils.

Although these soils have moderately low to moderately high permeability, these soils generally have a high water table and are susceptible to flooding and frost action (1). The cumulose drift in Blackford County is generally unsuitable as sites for septic tank fields or sanitary landfills (33). Because of frequent ponding, muck basins may be potential wetlands, which are protected under federal laws that limit any major construction activity in these areas. Knowledge of the location of the muck deposits is important due to the high compressibility and low strength of organic matter.

MINED LAND

Several gravel pits and a few limestone quarries exist in Blackford County.

Limestone Quarry

One limestone quarry is present in Blackfortd County. It is located just north of Montpelier at T24N, R11E.

Gravel Pits

Several gravel pits are located in Blackford County. Three gravel pits are located along the Big Lick Creek flood plain at T22N, R10E. Another gravel pit is located at T23N, R11E.

Gravel pits are generally found on outwash plains or terraces of major streams. The gravel pits are open excavations from which sand and gravel have been removed for construction material. Most of the gravel pits are shallow although some may reach 30 feet in depth. The abandoned pits are usually filled with water and may be considered as wetlands under federal law. Since these soils are highly variably and disturbed, a detailed site investigation is needed if these areas are to be used as sites for roads, buildings, and septic tank absorption fields(1).

SUMMARY OF ENGINEERING CONSIDERATIONS IN BLACKFORD COUNTY

A summary of the engineering considerations for each landform-parent material region in Blackford County is given in Table 5. Each of the landforms has been given a general rating (Low, Medium, High, or 1,2,3) for many of the specific highway or construction problems that may be encountered in Blackford County. The rankings, as shown in Figure 5 represent the average behavior and characteristics of the parent material and should only be used as a general guideline for planning a construction project in Blackford County.

Table 5: Summary of Engineering Considerations for Landform-Parent Material Regions in Blackford County

EXPLANATION

PROBABILITY OF A MAJOR PROBLEM DEVELOPING

L (LOW)

M (MEDIUM)

H (HIGH)

AVAILABILITY RATING

1 (LOW)

2 (MEDIUM)

3 (HIGH)

LANDFORM	GENERAL SOIL TEXTURE	CUT DESIGN					EMBANKMENT FILLS					EMBANKMENT FOUNDATION			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
							COMPACTED PROPERTIES								
		SOIL/ROCK BACKSLOPE INSTABILITY	GROUNDWATER CONTROL	EROSION POTENTIAL	SURFACE DRAINAGE	NATURAL SLOPE AND RIVER BANK INSTABILITY	EROSION RESISTANCE	RELATIVE PERMEABILITY	INADEQUATE SHEAR STRENGTH	COMPRESSIBILITY WHEN SATURATED	WORKABILITY PROBLEMS	INADEQUATE SHEAR STRENGTH	EXCESSIVE SETTLEMENTS	ORGANIC DEPOSIT OCCURRENCE	GROUNDWATER CONTROL
RIDGE MORAINE	SAND, SILT, CLAY	L	L/M	L/M	M	L	M	1	L/M	M	L	L	L	M/H	L/M
GROUND MORAINE	SAND, SILT, CLAY	L	L/M	L/M	M	L	M	1	L/M	M	L	L	L	M/H	L/M
LACUSTRINE PLAIN	CLAY, SILT	L	H	L/M	M/H	L	L	1	M/H	M/H	H	H	H	H	H
FLOOD PLAIN	CLAY, SILT, SAND	M	M	H	M/H	M	L/M	1,3	M	M	M	H	L/M	M	M
RIVER TERRACE	CLAY, SILT, SAND, GRAVEL	L	L/M	M	L	L/M	L	2,3	L	L	L	L/M	L	L/M	L/M
ORGANIC DEPOSITS	MUCK, MARL	M	H	H	H	L	L	1,2	H	H	H	H	H	H	H

LANDFORM	GENERAL SOIL TEXTURE	SUBGRADE				FOUNDATION DESIGN								MISCELLANEOUS				
		15	18	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
						SHALLOW FOOTINGS			PILES									
		SUBGRADE SUPPORT INADEQUATE	FROST ACTION POTENTIAL	PUMPING POTENTIAL	SHRINK-SWELL POTENTIAL	INADEQUATE BEARING CAPACITY	EXCESSIVE SETTLEMENT POTENTIAL	SCOUR POTENTIAL	INADEQUATE BEARING CAPACITY	EXCESSIVE SETTLEMENT POTENTIAL	NEGATIVE SKIN POTENTIAL	SCOUR POTENTIAL	ESTIMATION OF LATERAL EARTH PRESSURES FOR RETAINING STRUCTURES	AVAILABILITY OF AGGREGATE	STEEL CORROSIVITY	CONCRETE CORROSIVITY	BEHAVIOR OF SEPTIC TANK FIELDS	GROUNDWATER RESOURCE POTENTIAL
RIDGE MORAINE	SAND, SILT, CLAY	L/M	M	L/M	L/M	L	L	L	L	L	L/M	L/M	M	1	M	L	H	1
GROUND MORAINE	SAND, SILT, CLAY	L/M	M	M/H	L/M	M	L	L	L	L	L/M	L/M	M	1	M	L	H	1
LACUSTRINE PLAIN	CLAY, SILT	M/H	H	H	H	M/H	H	L/M	M/H	H	M/H	L/M	M	1	M	H	M/H	1
FLOOD PLAIN	CLAY, SILT, SAND	M	M	M	M	L/M	L/M	M	L/M	L/M	M	M/H	M	1,2	L	M	M/H	2
RIVER TERRACE	CLAY, SILT, SAND, GRAVEL	L	L/M	L/M	M/H	L	L	L	L	L	L	L	L	2,3	L	L	L/M	2
ORGANIC DEPOSITS	MUCK, MARL	H	H	H	H	H	H	H	M/H	H	H	H	H	1	H	H	H	1

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APPENDIX A

CLASSIFICATION TEST RESULTS FOR SELECTED ENGINEERING PROJECTS IN BLACKFORD COUNTY

APPENDIX A. CLASSIFICATION TEST RESULTS FOR SELECTED ENGINEERING PROJECTS IN BLACKFORD COUNTY (25-32)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	RQD %	Grain Size Distribution				LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay			
1	SR 303 over	1	15 + 00	13LT	847.3	0 - 3.5	Silty Clay		11								
"	Salamonie	2	"	"	"	3.5 - 5.0	Limestone		66								
2	River	1	16 + 70	35LT	844.8	0 - 2.5	Silty Clay Loam		75+								
"	"	2	"	"	"	2.5 - 7.3	Limestone		-								
3	"	1	17 + 90	35LT	840.1	7.3 - 8.8	Limestone		-								
4	"	1	18 + 50	5RT	845.6	0 - 3.5	Silty Loam		6								
"	"	2	"	"	"	3.5 - 6.0	Silty Clay		14								
"	"	3	"	"	"	6.0 - 8.5	Sandy Clay Loam		8								
"	"	4	"	"	"	8.5 - 10.0	Sand		60+								
"	"	5	"	"	"	10.0 - 14.8	Limestone		-								
5	"	1	20 + 00	5RT	845.0	0 - 1.0	Silty Clay Loam		39								
"	"	2	"	"	"	1.0 - 4.0	Limestone		104								
6	CR 900 East	1	28 + 00	48RT	860.6	0 - 2.5	Silty Clay Loam	A-6	14								
"	over	2	"	"	"	2.5 - 5.0	"	"	12								
"	Salamonie	3	"	"	"	5.0 - 7.5	"	"	14								
"	River	4	"	"	"	7.5 - 10.0	Sand	A-2-4	16								
7	"	1	26 + 00	55LT	858.5	0 - 2.5	Silty Clay Loam	A-6	15								
"	"	2	"	"	"	2.5 - 5.0	"	A-4(7)	6		0	16	62	22	31	22	9
"	"	3	"	"	"	5.0 - 7.5	Sand	A-2-4	7								
"	"	4	"	"	"	7.5 - 10.0	"	"	2								
"	"	5	"	"	"	10.0 - 12.0	Silty Clay Loam	A-6	6								
8	"	1	20 + 73	14RT	851.2	0 - 2.5	Sand	A-2-4	7								
"	"	2	"	"	"	2.5 - 5.0	Silty Clay Loam	A-4	3								
"	"	3	"	"	"	5.0 - 7.5	"	A-6	15								
"	"	4	"	"	"	7.5 - 10.0	Clay	A-6(7)	25		0	19	47	34	29	18	11
"	"	5	"	"	"	15.0 - 15.0	"	A-2-4(0)	47		3	85	12	12	N/P	N/P	N/P
"	"	6	"	"	"	15.0 - 20.0	Sand	A-2-4(0)	48								
"	"	7	"	"	"	20.0 - 25.0	"	A-2-4(0)	24								
"	"	8	"	"	"	25.0 - 30.0	"	A-4	20								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	RQD %	Grain Size Distribution				LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay			
9	CR 900 East	1	21 + 71	8LT	852.7	0 - 2.5	Silty Clay Loam	A-4	6								
"	over	2	"	"	"	2.5 - 5.0	"	"	5								
"	Salamonie	3	"	"	"	5.0 - 7.5	"	"	8								
"	River	4	"	"	"	7.5 - 10.0	Sand	A-2-4	4								
"	"	5	"	"	"	10.0 - 15.0	Silty Clay Loam	A-6	4								
"	"	6	"	"	"	15.0 - 20.0	Clay	A-6	22								
"	"	7	"	"	"	20.0 - 25.0	Sand	A-2-4	25								
"	"	8	"	"	"	25.0 - 30.0	Clay	A-6	36								
"	"	9	"	"	"	30.0 - 35.0	Sand	A-2-4	15								
"	"	10	"	"	"	35.0 - 40.0	"	"	35								
"	"	11	"	"	"	40.0 - 45.0	Silty Clay Loam	A-6	56								
"	"	12	"	"	"	45.0 - 50.0	"	"	28								
10	"	1	22 + 31	8RT	854.4	0 - 2.5	Silty Clay Loam	A-4	4								
"	"	2	"	"	"	2.5 - 5.0	"	"	4								
"	"	3	"	"	"	5.0 - 7.5	"	A-6	6								
"	"	4	"	"	"	7.5 - 10.0	"	"	7								
"	"	5	"	"	"	10.0 - 15.0	"	"	22								
"	"	6	"	"	"	15.0 - 20.0	Sandy Gravel	A-1-a	16								
"	"	7	"	"	"	20.0 - 25.0	Clay	A-6	18								
"	"	8	"	"	"	25.0 - 30.0	"	"	19								
"	"	9	"	"	"	30.0 - 35.0	Silt	"	30								
11	"	1	23 + 29	14LT	859.1	0 - 2.5	Silty Clay Loam	A-6	10								
"	"	2	"	"	"	2.5 - 5.0	"	"	15								
"	"	3	"	"	"	5.0 - 7.5	"	"	17								
"	"	4	"	"	"	7.5 - 10.0	"	"	14								
"	"	5	"	"	"	10.0 - 15.0	"	"	9								
"	"	6	"	"	"	15.0 - 20.0	Sandy Gravel	A-1-a(0)	21		60	37	3	3	N/P	N/P	N/P
"	"	7	"	"	"	20.0 - 25.0	"	"	35								
"	"	8	"	"	"	25.0 - 30.0	"	"	22								
"	"	9	"	"	"	30.0 - 35.0	Clay	A-6	32								
"	"	10	"	"	"	35.0 - 40.0	"	"	75								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description: Texture	Soil Description: AASHTO	Blow per Ft.	RQD %	Grain Size Distribution: Gravel	Sand	Silt	Clay	LL	PL	PI
12	CR 900 East	1	23 + 93	14RT	852.9	0 - 2.5	Silty Clay Loam	A-6	8								
"	over	2	"	"	"	2.5 - 5.0	Sand	A-2-4	9								
"	Salamonie	3	"	"	"	5.0 - 7.5	"	"	4								
"	River	4	"	"	"	7.5 - 10.0	Silty Clay Loam	A-6	2								
"	"	5	"	"	"	10.0 - 15.0	Sandy Gravel	A-1-a	40								
"	"	6	"	"	"	15.0 - 20.0	Clay	A-6	26								
"	"	7	"	"	"	20.0 - 25.0	"	"	20								
"	"	8	"	"	"	25.0 - 30.0	Sand	A-2-4	37								
13	"	1	24 + 23	8LT	854.6	0 - 2.5	Silty Clay Loam	A-6	10								
"	"	2	"	"	"	2.5 - 5.0	"	"	8								
"	"	3	"	"	"	5.0 - 7.5	Sand	A-2-4	6								
"	"	4	"	"	"	7.5 - 10.0	Sandy Gravel	A-1-a	5								
"	"	5	"	"	"	10.0 - 15.0	"	"	31								
"	"	6	"	"	"	15.0 - 20.0	"	"	22								
"	"	7	"	"	"	20.0 - 25.0	"	"	32								
"	"	8	"	"	"	25.0 - 30.0	"	"	22								
"	"	9	"	"	"	30.0 - 35.0	Clay	A-6	38								
14	"	1	24 + 75	8RT	852.7	0 - 2.5	Silty Clay Loam	A-6	9								
"	"	2	"	"	"	2.5 - 5.0	Clay	"	5								
"	"	3	"	"	"	5.0 - 7.5	Sand	A-2-4	3								
"	"	4	"	"	"	7.5 - 10.0	Silty Clay Loam	A-6	1								
"	"	5	"	"	"	10.0 - 15.0	"	"	21								
"	"	6	"	"	"	15.0 - 20.0	Sand	A-2-4	42								
"	"	7	"	"	"	20.0 - 25.0	Clay	A-6	39								
"	"	8	"	"	"	25.0 - 30.0	"	"	27								
"	"	9	"	"	"	30.0 - 35.0	"	"	26								
"	"	10	"	"	"	35.0 - 40.0	Sand	A-2-4	49								
"	"	11	"	"	"	40.0 - 45.0	Clay	A-6	35								
"	"	12	"	"	"	45.0 - 50.0	"	"	39								
15	"	1	25 + 06	14LT	856.2	0 - 2.5	Silty Clay Loam	A-6(8)	13								
"	"	2	"	"	"	2.5 - 5.0	"	"	9								
"	"	3	"	"	"	5.0 - 7.5	"	"	16								
"	"	4	"	"	"	7.5 - 10.0	Sand	A-2-4	13								
"	"	5	"	"	"	10.0 - 15.0	Silty Clay Loam	A-6(12)	3		0	5	68	27	35	23	12
"	"	6	"	"	"	15.0 - 20.0	Sand	A-2-4	18								
"	"	7	"	"	"	20.0 - 25.0	Sandy Gravel	A-1-a	60								
"	"	8	"	"	"	25.0 - 30.0	Clay	A-6	34								
"	"	9	"	"	"	30.0 - 35.0	"	"	36								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	RQD %	Grain Size Distribution				LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay			
16	SR 3 over	1	786 + 65	45LT	875.3	0 - 2.5	Sandy Loam	A-4(0)	18		6	51	25	18	25	18	8
"	Little Lick	2	"	"	"	2.5 - 5.0	"	"	16								
"	Creek	3	"	"	"	5.0 - 7.5	"	"	4								
17	"	1	786 + 77	23LT	875. 1	0 - 2.5	Clay Loam	A-4(2)	16		7	36	33	24	24	15	9
"	"	2	"	"	"	2.5 - 5.0	"	"	12								
"	"	3	"	"	"	5.0 - 7.5	Silty Clay Loam	A-6(11)	9		0	15	56	29	36	23	13
"	"	4	"	"	"	7.5 - 10.0	"	"	13								
"	"	5	"	"	"	10.0 - 15.0	Sand	A-2-4	21								
"	"	6	"	"	"	15.0 - 20.0	Sandy Loam	-	46								
"	"	7	"	"	"	20.0 - 25.0	Sand	-	38								
"	"	8	"	"	"	25.0 - 30.0	Gravelly Sand	A-1-b(0)	35		29	63	8	8	N/P	N/P	N/P
18	"	1	788 + 18	18RT	876.0	0 - 2.5	Silty Clay	A-6	12								
"	"	2	"	"	"	2.5 - 5.0	Sand	-	4								
"	"	3	"	"	"	5.0 - 7.5	Loam	A-4(0)	4		7	41	36	16	N/P	N/P	N/P
"	"	4	"	"	"	7.5 - 10.0	Sand	A-2-4(0)	18		0	86	14	14	N/P	N/P	N/P
"	"	5	"	"	"	10.0 - 15.0	"	A-2-4	25								
"	"	6	"	"	"	15.0 - 20.0	"	"	16								
"	"	7	"	"	"	20.0 - 25.0	Gravelly Sand	A-1-6	37								
"	"	8	"	"	"	25.0 - 30.0	"	"	30								
"	"	9	"	"	"	30.0 - 35.0	"	"	18								
"	"	10	"	"	"	35.0 - 40.0	Sand & Gravel	A-1-a(0)	43		50	42	8	8	N/P	N/P	N/P
"	"	11	"	"	"	40.0 - 45.0	Sand	A-2-4	49								
"	"	12	"	"	"	45.0 - 50.0	"	"	54								
19	"	1	787 + 38	27RT	867.2	0 - 2.5	Loam	A-4	6								
"	"	2	"	"	"	2.5 - 5.0	"	"	4								
"	"	3	"	"	"	5.0 - 7.5	"	"	13								
"	"	4	"	"	"	7.5 - 10.0	Silty Clay Loam	A-6	13								
"	"	5	"	"	"	10.0 - 15.0	Gravelly Sand	A-1-6	38								
"	"	6	"	"	"	15.0 - 20.0	Sand	A-2-4	36								
"	"	7	"	"	"	20.0 - 25.0	"	"	30								
"	"	8	"	"	"	25.0 - 30.0	Gravelly Sand	A-1-6	21								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	RQD %	Grain Size Distribution				LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay			
20	SR 3 over	1	748 + 5	40LT	875.3	0 - 2.5	Clay	-	-								
"	Big Lick	2	"	"	"	2.5 - 5.0	Silt	-	-								
"	Creek	3	"	"	"	5.0 - 10.0	Silty Clay	-	9								
"	"	4	"	"	"	10.0 - 15.0	Clay	-	5								
"	"	5	"	"	"	15.0 - 20.0	Silty Clay	-	8								
"	"	6	"	"	"	20.0 - 25.0	"	-	14								
"	"	7	"	"	"	25.0 - 30.0	"	-	21								
"	"	8	"	"	"	30.0 - 35.0	"	-	20								
"	"	9	"	"	"	35.0 - 38.0	"	-	23								
"	"	10	"	"	"	38.0 - 43.0	Sand	-	23								
"	"	11	"	"	"	43.0 - 45.0	"	-	39								
21	"	1	749 + 00	30LT	866.3	0 - 2.5	Silty Clay	-	-								
"	"	2	"	"	"	2.5 - 5.0	Sand	-	-								
"	"	3	"	"	"	5.0 - 10.0	"	-	0								
"	"	4	"	"	"	10.0 - 15.0	Clay	-	2								
"	"	5	"	"	"	15.0 - 20.0	"	-	1								
"	"	6	"	"	"	20.0 - 25.0	Silty Clay	-	1								
"	"	7	"	"	"	25.0 - 30.0	"	-	20								
"	"	8	"	"	"	30.0 - 35.0	"	-	40								
"	"	9	"	"	"	35.0 - 38.0	"	-	21								
"	"	10	"	"	"	38.0 - 40.0	"	-	37								
22	"	1	749 + 33	25RT	872.2	0 - 2.5	Silty Clay	-	-								
"	"	2	"	"	"	2.5 - 5.0	Clayey Silt	-	-								
"	"	3	"	"	"	5.0 - 10.0	Clay	-	6								
"	"	4	"	"	"	10.0 - 15.0	"	-	6								
"	"	5	"	"	"	15.0 - 20.0	Silty Clay	-	2								
"	"	6	"	"	"	20.0 - 25.0	"	-	3								
"	"	7	"	"	"	25.0 - 30.0	Sand	-	3								
"	"	8	"	"	"	30.0 - 35.0	"	-	2								
"	"	9	"	"	"	35.0 - 40.0	Clay	-	1								
"	"	10	"	"	"	40.0 - 45.0	Silty Clay	-	10								
"	"	11	"	"	"	45.0 - 50.0	"	-	16								
"	"	12	"	"	"	50.0 - 55.0	"	-	14								
"	"	13	"	"	"	55.0 - 56.5	"	-	24								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description: Texture	Soil Description: AASHTO	Blow per Ft.	RQD %	Grain Size Distribution: Gravel	Sand	Silt	Clay	LL	PL	PI
23	SR 3 over	1	749 + 58	25LT	871.9	0 - 2.5	Silty Clay	-	-								
"	Big Lick	2	"	"	"	2.5 - 5.0	"	-	-								
"	Creek	3	"	"	"	5.0 - 10.0	"	-	8								
"	"	4	"	"	"	10.0 - 15.0	Clay	-	6								
"	"	5	"	"	"	15.0 - 20.0	Silty Clay	-	4								
"	"	6	"	"	"	20.0 - 25.0	"	-	5								
"	"	7	"	"	"	25.0 - 30.0	"	-	3								
"	"	8	"	"	"	30.0 - 35.0	"	-	4								
"	"	9	"	"	"	35.0 - 40.0	Sandy Silt	-	2								
"	"	10	"	"	"	40.0 - 45.0	Clay	-	4								
"	"	11	"	"	"	45.0 - 50.0	Silty Clay	-	21								
24	"	1	748 + 71	25RT	865.3	0 - 2.5	Sand	-	-								
"	"	2	"	"	"	2.5 - 5.0	Sand	-	-								
"	"	3	"	"	"	5.0 - 10.0	Clay	-	-								
"	"	4	"	"	"	10.0 - 15.0	"	-	-								
"	"	5	"	"	"	15.0 - 20.0	Silty Clay	-	24								
"	"	6	"	"	"	20.0 - 25.0	"	-	25								
"	"	7	"	"	"	25.0 - 27.0	"	-	23								
"	"	8	"	"	"	27.0 - 30.0	"	-	30								
25	SR 167 over	1	49 + 62.5	30RT	916.1	0 - 2.5	Clay	A-7-6(23)	13								
"	Baker-Bantz	2	"	"	"	2.5 - 5.0	"	"	9		0.3	19.7	36.7	43.3	48.4	20.4	28.0
"	Ditch	3	"	"	"	5.0 - 7.5	Silty Loam	A-4(1)	4								
"	"	4	"	"	"	7.5 - 10.0	"	"	11								
"	"	5	"	"	"	10.0 - 15.0	"	"	9		0	18.1	68.2	13.7	20.4	15.9	4.5
"	"	6	"	"	"	15.0 - 20.0	Sand	A-3(0)	25								
"	"	7	"	"	"	20.0 - 25.0	"	"	30								
"	"	8	"	"	"	25.0 - 30.0	"	"	23		0.2	95.0	4.8	4.8	N/P	N/P	N/P
"	"	9	"	"	"	30.0 - 35.0	"	"	31								
26	"	1	49 + 85.5	23RT	915.9	0 - 2.5	Clay	A-7-6(28)	17		0.2	12.9	38.0	48.9	56.4	27.8	28.6
"	"	2	"	"	"	2.5 - 5.0	"	"	11								
"	"	3	"	"	"	5.0 - 7.5	"	"	10								
"	"	4	"	"	"	7.5 - 10.0	Silty Loam	A-4	10								
"	"	5	"	"	"	10.0 - 15.0	"	"	8								
"	"	6	"	"	"	15.0 - 20.0	Sand	A-3	10								
"	"	7	"	"	"	20.0 - 25.0	"	"	16								
"	"	8	"	"	"	25.0 - 30.0	"	"	27								
"	"	9	"	"	"	30.0 - 35.0	Loam	A-4(1)	21								
"	"	10	"	"	"	35.0 - 40.0	"	"	35								
"	"	11	"	"	"	40.0 - 45.0	"	"	47								
"	"	12	"	"	"	45.0 - 50.0	"	"	74		8.4	26.8	49.9	14.9	20.7	14.5	6.2

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description: Texture	Soil Description: AASHTO	Blow per Ft.	RQD %	Grain Size Distribution: Gravel	Sand	Silt	Clay	LL	PL	PI
27	"	1	50 + 37	27LT	915.3	0 - 2.5	Clay	A-7-6(18)	53		17.7	8.3	39.7	34.3	47.3	21.8	25.5
"	"	2	"	"	"	2.5 - 5.0	"	"	11								
"	"	3	"	"	"	5.0 - 7.5	"	"	8								
"	"	4	"	"	"	7.5 - 10.0	Silty Loam	A-4	19								
"	"	5	"	"	"	10.0 - 15.0	"	A-4(2)	11		0.7	12.8	67.7	18.8	21.2	16.4	4.8
"	"	6	"	"	"	15.0 - 20.0	"	"	28								
"	"	7	"	"	"	20.0 - 25.0	Sand	A-3	29								
"	"	8	"	"	"	25.0 - 30.0	"	"	24								
"	"	9	"	"	"	30.0 - 35.0	Silty Loam	A-4	35								
"	"	10	"	"	"	35.0 - 40.0	Sand	A-3	23								
28	SR 26 over Moore Prong Ditch	1	49 + 71	44LT	891.5	0 - 2.5	Clay Loam	A-4	15								
"		2	"	"	"	2.5 - 5.0	"	-	23								
"		3	"	"	"	5.0 - 7.5	"	-	42								
"	"	4	"	"	"	7.5 - 10.0	"	-	36								
"	"	5	"	"	"	10.0 - 15.0	"	-	56								
"	"	6	"	"	"	15.0 - 20.0	Silt	A-4(0)	36		0.0	14.7	81.0	4.3	N/P	N/P	N/P
"	"	7	"	"	"	20.0 - 25.0	"	-	54								
"	"	8	"	"	"	25.0 - 30.0	Clay	-	35								
29	"	1	50 + 00	44RT	894.8	0 - 2.5	Clay	A-6	5								
"	"	2	"	"	"	2.5 - 5.0	Clay Loam	A-4(4)	27								
"	"	3	"	"	"	5.0 - 7.5	"	-	21								
"	"	4	"	"	"	7.5 - 10.0	"	-	22						24	15	9
"	"	5	"	"	"	10.0 - 15.0	"	-	24		6.7	21.6	45.8	25.9	24	15	9
"	"	6	"	"	"	15.0 - 20.0	"	-	30								
"	"	7	"	"	"	20.0 - 25.0	"	-	26								
"	"	8	"	"	"	25.0 - 30.0	"	-	21								
30	"	1	48 + 00	20.5LT	897.3	0 - 2.5	Clay	A-6(12)	12								
"	"	2	"	"	"	2.5 - 5.0	"	A-4	10		8.6	19.3	40.9	31.2	27	18	9
"	"	3	"	"	"	5.0 - 7.5	Clay Loam	-	17								
31	SR 26 over Tyner Ditch	1	265 + 95	23LT	890.6	0 - 2.5	Clay	A-7-6	9								
"		2	"	"	"	2.5 - 5.0	"	"	9								
"	"	3	"	"	"	5.0 - 7.5	"	"	8								
"	"	4	"	"	"	7.5 - 10.0	Clay Loam	A-4	24								
"	"	5	"	"	"	10.0 - 15.0	"	"	24								
"	"	6	"	"	"	15.0 - 20.0	"	"	17								
"	"	7	"	"	"	20.0 - 25.0	"	"	20								
"	"	8	"	"	"	25.0 - 30.0	Loam	-	55								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description: Texture	Soil Description: AASHTO	Blow per Ft.	RQD %	Grain Size Distribution: Gravel	Sand	Silt	Clay	LL	PL	PI
32	SR 26 over	1	266 + 34	28RT	883.7	0 - 2.5	Clay	A-7-6	5								
"	Tyner Ditch	2	"	"	"	2.5 - 5.0	"	"	25								
"	"	3	"	"	"	5.0 - 7.5	"	"	23								
"	"	4	"	"	"	7.5 - 10.0	"	"	23								
"	"	5	"	"	"	10.0 - 15.0	Clay Loam	A-4(5)	34		7.5	20.8	43.4	28.3	27	17	10
"	"	6	"	"	"	15.0 - 20.0	"	"	19								
"	"	7	"	"	"	20.0 - 25.0	"	"	29								
"	"	8	"	"	"	25.0 - 30.0	"	"	35								
"	"	9	"	"	"	30.0 - 35.0	"	"	25								
"	"	10	"	"	"	35.0 - 40.0	"	"	23								
"	"	11	"	"	"	40.0 - 45.0	"	"	23								
"	"	12	"	"	"	45.0 - 50.0	"	"	26								
33	"	1	266 + 85	23RT	890.0	0 - 2.5	Clay	A-7-6(32)	5								
"	"	2	"	"	"	2.5 - 5.0	"	"	8		1.2	13.3	34.4	51.1	58	23	35
"	"	3	"	"	"	5.0 - 7.5	"	"	6								
"	"	4	"	"	"	7.5 - 10.0	Sand & Gravel	A-1-b(0)	28		41.8	49.7	8.5	8.5	N/P	N/P	N/P
"	"	5	"	"	"	10.0 - 15.0	Clay Loam	A-4	42								
"	"	6	"	"	"	15.0 - 20.0	"	"	26								
"	"	7	"	"	"	20.0 - 25.0	"	"	24								
"	"	8	"	"	"	25.0 - 30.0	"	"	44								
34	"	1	264 + 00	30RT	886.2	0 - 2.5	Clay	A-7-6	6								
"	"	2	"	"	"	2.5 - 5.0	"	"	20								
"	"	3	"	"	"	5.0 - 7.5	"	"	30								
35	SR 167 over	1	49 + 67	7LT	901.4	0 - 2.5	Silty Loam	-	15								
"	Mud Creek &	2	"	"	"	2.5 - 5.0	Clay	A-6	7								
"	Branch of	3	"	"	"	5.0 - 7.5	"	"	12								
"	Mud Creek	4	"	"	"	7.5 - 10.0	"	"	35								
"	"	5	"	"	"	12.5 - 15.0	"	"	34								
"	"	6	"	"	"	17.5 - 20.0	"	"	15								
"	"	7	"	"	"	22.5 - 20.0	"	"	16								
"	"	8	"	"	"	37.5 - 30.0	"	"	18								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description: Texture	Soil Description: AASHTO	Blow per Ft.	RQD %	Grain Size Distribution: Gravel	Sand	Silt	Clay	LL	PL	PI
36	SR 167 over	1	50 + 00	23RT	896.8	0 - 4.0	Sandy Gravel	-	27								
"	Mud Creek &	2	"	"	"	4.0 - 6.5	Clay	A-6	29								
"	Branch of	3	"	"	"	6.5 - 9.0	"	"	19								
"	Mud Creek	4	"	"	"	9.0 - 11.5	"	"	18								
"	"	5	"	"	"	11.5 - 16.5	"	"	17								
"	"	6	"	"	"	16.5 - 21.5	"	"	17								
"	"	7	"	"	"	21.5 - 26.5	Sand	-	7								
"	"	8	"	"	"	26.5 - 31.5	Loam	A-4	15								
"	"	9	"	"	"	31.5 - 36.5	"	"	15								
"	"	10	"	"	"	36.5 - 41.5	Silty Loam	A-4(0)	40		0	29	67	4	NP	NP	NP
"	"	11	"	"	"	41.5 - 46.5	Loam	"	92+		5	41	46	8	NP	NP	NP
"	"	12	"	"	"	46.5 - 50.9	"	"	83+								
37	"	1	50 + 37	8RT	901.6	0 - 2.5	Sandy Gravel	-	7								
"	"	2	"	"	"	2.5 - 5.0	Clay	A-6	8								
"	"	3	"	"	"	5.0 - 7.5	"	"	8								
"	"	4	"	"	"	7.5 - 10.0	"	A-6(13)	22		0	14	44	42	36	20	16
"	"	5	"	"	"	10.0 - 15.0	"	A-6	15								
"	"	6	"	"	"	15.0 - 20.0	"	"	15								
"	"	7	"	"	"	20.0 - 25.0	"	"	12								
"	"	8	"	"	"	25.0 - 30.0	"	"	17								
"	"	9	"	"	"	30.0 - 35.0	Silty Loam	A-4	11								
"	"	10	"	"	"	35.0 - 40.0	Sand	A-2-4	26								
"	"	11	"	"	"	40.0 - 45.0	Loam	A-4	23								
"	"	12	"	"	"	45.0 - 50.0	Sand	A-2-4(0)	46		0	89	11	11	N/P	N/P	N/P
"	"	13	"	"	"	50.0 - 55.0	Loam	A-4	53								
"	"	14	"	"	"	55.0 - 60.0	Sand	A-2-4	62								
38	"	1	36 + 70	19RT	901.2	0 - 2.5	Clay	A-6	18								
"	"	2	"	"	"	2.5 - 6.0	"	"	38								
39	"	1	38 + 36	50RT	908.2	0 - 2.5	Gravel	A-6	13								
"	"	2	"	"	"	2.5 - 5.0	Clay	"	23								
"	"	3	"	"	"	5.0 - 7.5	"	"	23								
"	"	4	"	"	"	7.5 - 10.0	Silty Loam	A-4	29								

APPENDIX A. (CONTINUED)

Boring No.	Project	Sample No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	RQD %	Grain Size Distribution				LL	PL	PI
							Texture	AASHTO			Gravel	Sand	Silt	Clay			
40	"	1	42 + 00	26LT	898.5	0 - 2.5	Silty Loam	A-4	13								
"	"	2	"	"	"	2.5 - 5.0	"	"	12								
"	"	3	"	"	"	5.0 - 7.5	Clay	A-6	13								
41	"	1	47 + 00	48RT	900.4	0 - 2.5	Clay	A-6-(16)	11		0	20	47	33	38	17	21
"	"	2	"	"	"	2.5 - 5.0	"	"	10								
"	"	3	"	"	"	5.0 - 7.5	Sand	A-2-4	6								

APPENDIX B

PHYSICAL AND CHEMICAL PROPERTIES OF AGRICULTURAL SOILS IN BLACKFORD COUNTY

APPENDIX B. PHYSICAL AND CHEMICAL PROPERTIES OF AGRICULTURAL SOILS IN BLACKFORD COUNTY (1)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cm^3	In/hr	In/in	pH					Pct
BlA: Blount----------	0-9	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.43	3	6	2-3
	9-34	35-50	1.40-1.70	0.06-0.6	0.12-0.19	4.5-8.4	Moderate-----	0.43			
	34-60	27-38	1.60-1.85	0.06-0.6	0.07-0.10	7.4-8.4	Moderate-----	0.43			
Glynwood--------	0-9	27-38	1.35-1.55	0.2-0.6	0.17-0.22	5.6-7.3	Low----------	0.43	2	6	1-2
	9-20	35-55	1.45-1.75	0.06-0.2	0.11-0.18	4.5-7.8	Moderate-----	0.32			
	20-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			
Bo--------------- Bono	0-9	35-45	1.20-1.45	0.2-2.0	0.20-0.23	6.1-7.3	High---------	0.28	5	4	4-8
	9-49	38-55	1.35-1.55	<0.2	0.10-0.14	6.1-8.4	High---------	0.28			
	49-80	8-45	1.25-1.50	0.6-2.0	0.10-0.18	7.4-8.4	Moderate-----	0.28			
Bs--------------- Bono Variant	0-10	40-60	0.85-1.40	0.2-6.0	0.20-0.25	5.1-6.0	Low----------	0.28	5	2	20-31
	10-33	38-60	1.35-1.55	<0.06	0.11-0.18	6.1-7.8	Moderate-----	0.28			
	33-60	40-60	1.45-1.60	<0.06	0.10-0.12	7.4-8.4	Moderate-----	0.28			
Ee--------------- Eel	0-9	27-32	1.35-1.55	0.6-2.0	0.21-0.23	6.1-7.3	Low----------	0.37	5	6	1-2
	9-40	18-32	1.30-1.50	0.6-2.0	0.17-0.22	5.6-7.8	Low----------	0.37			
	40-60	10-27	1.30-1.50	0.6-2.0	0.19-0.21	6.1-8.4	Low----------	0.37			
Ef--------------- Eel Variant	0-11	35-45	1.45-1.55	0.6-2.0	0.12-0.19	6.1-7.3	Low----------	0.32	5	4	2-4
	11-60	35-45	1.45-1.60	0.2-0.6	0.09-0.19	4.5-7.3	Moderate-----	0.32			
ElA-------------- Eldean	0-11	15-25	1.30-1.50	0.6-2.0	0.18-0.22	5.6-7.3	Low----------	0.37	4	5	2-3
	11-33	35-48	1.40-1.60	0.2-2.0	0.08-0.14	5.6-7.8	Moderate-----	0.37			
	33-60	2-8	---	>6.0	0.01-0.04	7.4-8.4	Low----------	0.10			
EnB3, EnC3------- Eldean	0-8	27-33	1.35-1.55	0.6-2.0	0.16-0.18	5.6-7.3	Low----------	0.37	3	6	2-3
	8-32	35-48	1.40-1.60	0.2-2.0	0.08-0.14	5.6-7.8	Moderate-----	0.37			
	32-60	2-8	---	>6.0	0.01-0.04	7.4-8.4	Low----------	0.10			
GsB3, GsC3------- Glynwood	0-9	27-38	1.35-1.55	0.2-0.6	0.17-0.22	5.6-7.3	Low----------	0.43	2	6	1-2
	9-20	35-55	1.45-1.75	0.06-0.2	0.11-0.18	4.5-7.8	Moderate-----	0.32			
	20-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			
Ho--------------- Houghton	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	2	2	>70
MaA, MaB2-------- Martinsville	0-9	8-20	1.30-1.45	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.37	5	5	2-3
	9-48	20-33	1.40-1.60	0.6-2.0	0.16-0.20	5.1-7.3	Moderate-----	0.37			
	48-65	8-25	1.25-1.60	0.6-2.0	0.12-0.17	5.1-7.8	Low----------	0.24			
MoD3------------- Morley	0-5	27-35	1.40-1.60	0.2-0.6	0.18-0.22	5.1-6.5	Moderate-----	0.43	2	7	1-3
	5-22	35-50	1.55-1.70	0.2-0.6	0.11-0.15	6.1-7.8	Moderate-----	0.43			
	22-60	27-40	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
Pm--------------- Pewamo	0-10	40-45	1.35-1.55	0.2-0.6	0.12-0.20	6.1-7.3	Moderate-----	0.24	5	4	4-5
	10-28	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	Moderate-----	0.24			
	28-60	30-40	1.50-1.75	0.2-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.24			
So--------------- Saranac	0-12	40-50	0.90-1.50	0.06-0.2	0.12-0.20	6.1-7.3	Moderate-----	0.24	5	4	4-6
	12-46	27-60	1.30-1.80	0.06-0.6	0.10-0.20	6.1-7.3	Moderate-----	0.24			
	46-60	10-35	1.40-1.95	0.06-0.6	0.10-0.20	6.1-7.3	Low----------	0.24			
St--------------- Saranac	0-10	40-60	0.90-1.50	0.06-0.2	0.12-0.20	6.1-7.8	Moderate-----	0.24	5	4	4-6
	10-44	35-60	1.30-1.80	0.2-0.6	0.10-0.20	5.6-7.8	Moderate-----	0.24			
	44-60	18-45	1.50-1.95	0.06-0.6	0.10-0.20	6.6-8.4	Moderate-----	0.24			
Wa--------------- Wallkill Variant	0-8	40-60	1.20-1.45	0.06-0.2	0.10-0.14	5.6-6.5	High---------	0.28	5	4	4-8
	8-17	38-60	1.35-1.55	0.06-0.2	0.08-0.12	5.1-6.5	High---------	0.28			
	17-36	---	---	0.2-6.0	0.35-0.45	5.1-7.3	-------------	----			
	36-60	---	---	0.06-0.2	0.18-0.24	6.6-8.4	-------------	----			
Wh--------------- Whitaker	0-13	8-19	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.37	5	5	2-3
	13-43	18-30	1.40-1.60	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.37			
	43-65	3-18	1.50-1.70	0.6-6.0	0.19-0.21	6.1-8.4	Low----------	0.37			

APPENDIX C

ENGINEERING INDEX PROPERTIES OF AGRICULTURAL SOILS IN BLACKFORD COUNTY

APPENDIX C. ENGINEERING INDEX PROPERTIES OF AGRICULTURAL SOILS IN BLACKFORD COUNTY (1)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
BlA:											
Blount	0-9	Silt loam	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
	9-34	Silty clay loam, clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
	34-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
Glynwood	0-9	Clay loam	CL	A-6, A-7	0-2	95-100	85-100	75-100	60-95	30-45	11-19
	9-20	Clay, clay loam	CL, CH	A-6, A-7	0-5	95-100	85-100	75-100	65-95	35-55	14-30
	20-60	Clay loam, silty clay loam.	CL	A-4, A-6	0-5	95-100	80-100	75-95	65-90	25-40	8-16
Bo	0-9	Silty clay	CH, CL	A-7	0	100	98-100	95-100	80-95	40-60	20-35
Bono	9-49	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	98-100	95-100	90-100	40-66	26-44
	49-80	Stratified silty clay to coarse sand.	CH, CL, CL-ML, SM	A-7, A-6, A-2	0	100	95-100	70-95	30-80	<35	NP-15
Bs	0-10	Mucky silty clay	CL, CH, MH	A-7	0	100	100	95-100	90-95	40-65	15-30
Bono Variant	10-33	Silty clay loam, silty clay.	CL, CH, MH	A-7	0	100	100	95-100	85-95	40-65	15-30
	33-60	Silty clay, silty clay loam.	CL, CH, MH	A-7	0	100	100	95-100	90-95	40-65	15-30
Ee	0-9	Clay loam	CL	A-6	0	100	100	95-100	80-90	30-40	10-16
Eel	9-40	Silt loam, loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	24-40	3-15
	40-60	Stratified sandy loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	90-100	70-80	55-70	24-40	3-15
Ef	0-11	Silty clay	CL	A-7, A-6	0	100	100	90-100	70-95	35-50	15-25
Eel Variant	11-60	Silty clay, silty clay loam.	CL	A-7, A-6	0	100	100	90-100	70-95	35-50	15-25
ElA	0-11	Silt loam	ML, CL-ML, CL	A-4, A-6	0	85-100	80-100	70-100	55-90	20-40	4-14
Eldean	11-33	Clay, gravelly sandy clay, gravelly clay loam.	CL, ML	A-7, A-6	0-5	75-100	60-100	55-95	50-80	35-50	12-23
	33-60	Stratified sand to gravel.	GM, SM, GP-GM, SP-SM	A-1, A-2	0-15	30-70	20-50	5-40	0-35	---	NP
EnB3, EnC3	0-8	Clay loam	CL	A-6, A-4	0-5	85-100	75-100	65-100	55-80	25-40	9-18
Eldean	8-32	Clay, gravelly sandy clay, gravelly clay loam.	CL, ML	A-7, A-6	0-5	75-100	60-100	55-95	50-80	35-50	12-23
	32-60	Stratified sand to gravel.	GM, SM, GP-GM, SP-SM	A-1, A-2	0-15	30-70	20-50	5-40	0-35	---	NP
GsB3, GsC3	0-9	Clay loam	CL	A-6, A-7	0-2	95-100	85-100	75-100	60-95	30-45	11-19
Glynwood	9-20	Clay, clay loam	CL, CH	A-6, A-7	0-5	95-100	85-100	75-100	65-95	35-55	14-30
	20-60	Clay loam, silty clay loam.	CL	A-4, A-6	0-5	95-100	80-100	75-95	65-90	25-40	8-16
Ho	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Houghton											

APPENDIX C. (CONTINUED)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
MaA, MaB2---------- Martinsville	0-9	Loam---------------	CL, CL-ML, ML	A-4	0	100	85-100	75-100	65-90	<25	3-8
	9-48	Clay loam, sandy loam, sandy clay loam.	CL, SC	A-4, A-6, A-2	0	95-100	85-100	70-100	30-95	25-40	7-15
	48-65	Stratified silt loam to loamy coarse sand.	SM, CL-ML, CL, SC	A-2, A-4, A-6	0	95-100	85-100	55-95	30-75	20-30	NP-11
MoD3-------------- Morley	0-5	Clay loam----------	CL	A-6, A-7	0-5	95-100	90-100	85-95	80-90	30-45	15-25
	5-22	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	22-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-60	15-30
Pm---------------- Pewamo	0-10	Silty clay---------	CH	A-7	0-5	90-100	80-100	80-100	75-95	50-55	25-30
	10-28	Clay loam, clay, silty clay.	CL, CH	A-7, A-6	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	28-60	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	90-100	90-100	70-90	40-50	15-25
So---------------- Saranac	0-12	Clay---------------	CL, CH, ML, MH	A-7	0	100	95-100	90-100	80-95	40-55	15-25
	12-46	Clay, clay loam	CL, CH	A-6, A-7	0	100	95-100	90-100	70-90	30-60	10-30
	46-60	Gravelly loam------	CL-ML, ML	A-4	0	100	85-100	75-90	65-85	15-40	3-20
St---------------- Saranac	0-10	Clay---------------	CL, CH	A-7	0	100	100	95-100	80-95	40-55	20-35
	10-44	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	95-100	90-100	70-90	40-60	20-35
	44-60	Stratified silty clay loam to sandy loam.	CL, CH, SM-SC	A-7, A-6, A-4	0	100	95-100	90-100	70-90	40-60	20-35
Wa---------------- Wallkill Variant	0-8	Silty clay---------	CH, CL	A-7	0	100	100	90-100	75-95	40-65	20-40
	8-17	Silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-65	20-40
	17-36	Sapric material	PT	A-8	0	---	---	---	---	---	---
	36-60	Coprogenous earth	OH, OL	A-8	0	---	---	---	---	---	---
Wh---------------- Whitaker	0-13	Silt loam----------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	80-100	60-90	15-35	2-15
	13-43	Clay loam, loam, sandy clay loam.	CL, CL-ML	A-6, A-4	0	100	95-100	90-100	70-80	20-35	5-15
	43-65	Stratified coarse sand to silt loam.	ML, SM, CL-ML, SM-SC	A-4	0	98-100	98-100	60-85	40-60	<25	NP-7

APPENDIX D

STATISTICAL STREAM FLOW DATA FOR BIG LICK CREEK NEAR HARTFORD CITY, BLACKFORD COUNTY

APPENDIX D. STATISTICAL STREAM FLOW DATA FOR BIGLICK CREEK

WABASH RIVER BASIN

03326070 BIG LICK CREEK NEAR HARTFORD CITY, IN

LOCATION.--Lat 40°25'20", long 85°21'04", in SE¼SE¼ sec.23, T.23 N., R.10 E., Blackford County, Hydrologic Unit 05120103, on right bank 6 ft downstream from bridge on County Road 100 East, and 2.0 mi southeast of Hartford City.

DRAINAGE AREA.--29.2 mi^2.

PERIOD OF RECORD.--July 1971 to September 1985.

GAGE.--Water-stage recorder. Datum of gage is 865.00 ft above National Geodetic Vertical Datum of 1929.

AVERAGE DISCHARGE.--14 years, 27.5 ft^3/s, 12.79 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 1940 ft^3/s June 6, 1981, gage height, 16.14 ft; minimum daily, 0.19 ft^3/s Oct. 4, 1983.

DURATION TABLE OF DAILY MEAN DISCHARGES FOR YEAR ENDING SEPTEMBER 30

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
YEAR	NUMBER OF DAYS IN CLASS																																		
1972					1		9	9	22	11	14	22	33	23	14	8	15	23	32	27	16	22	21	11	7	6	7	4	5	1	2	1			
1973										1	15	18	9	18	31	40	38	20	24	32	21	27	21	8	11	8	12	2	2	3	3	1			
1974							6	16	19	21	34	21	17	25	28	25	25	21	20	11	11	8	8	10	6	11	6	6	6	1	3				
1975						1	8	9	11	18	48	32	23	24	20	20	14	18	24	17	14	12	14	6	7	11	5	4	2	1	1	1			
1976					5	14	14	6	18	23	30	53	39	30	16	14	15	18	16	10	6	6	4	7	4	5	4	3	2	1	4	1			
1977						31	40	43	43	40	38	27	18	10	9	13	10	6	4	8	3	3	5	6	1	4	1		1		1				
1978						2	1	7	14	10	19	51	71	26	23	20	15	7	16	8	13	7	10	5	7	8	7	3	5	2	5	3			
1979								7	27	7	13	35	45	45	36	37	16	15	18	14	4	10	2	7	7	5	7	3	2	2		1			
1980									3	14	32	50	34	35	29	24	22	10	13	13	18	8	7	12	10	12	1	7	3	4	2	2	1		
1981									2	17	23	33	30	44	38	22	22	11	19	14	15	17	15	11	5	5	9	4	2	2	3	1			1
1982							13	14	25	24	37	29	15	37	27	19	14	12	10	12	8	13	8	9	2	7	8	8	8	3	3	1	1		
1983				10	10	15	36	30	24	21	18	28	29	23	19	22	16	10	8	9	4	6	4	5	4	4	8	2	1	1					
1984		3	1	3		2	2	2	1	22	33	29	28	27	30	31	21	16	22	16	10	8	10	8	6	12	7	7	6	1	1	1			
1985							2	14	44	27	35	37	38	27	24	21	14	16	10	13	4	7	6	7	1	3	7	1	2	1	2	1			1

CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT
0	0.00	0	5114	100.00	12	3.4	429	3369	65.88	24	80.0	78	438	8.56
1	0.19	3	5114	100.00	13	4.4	394	2940	57.49	25	100.0	101	360	7.04
2	0.25	1	5111	99.94	14	5.8	344	2546	49.78	26	130.0	89	259	5.06
3	0.32	13	5110	99.92	15	7.5	316	2202	43.06	27	180.0	54	170	3.32
4	0.42	16	5097	99.67	16	9.8	257	1886	36.88	28	230.0	45	116	2.27
5	0.54	65	5081	99.35	17	13.0	203	1629	31.85	29	300.0	23	71	1.39
6	0.71	131	5016	98.08	18	16.0	236	1426	27.88	30	380.0	30	48	0.94
7	0.92	157	4885	95.52	19	21.0	204	1190	23.27	31	500.0	14	18	0.35
8	1.2	251	4728	92.45	20	28.0	147	986	19.28	32	650.0	2	4	0.08
9	1.6	256	4477	87.54	21	36.0	154	839	16.41	33	850.0	0	2	0.04
10	2.0	389	4221	82.54	22	47.0	135	685	13.39	34	1100.0	2	2	0.04
11	2.6	463	3832	74.93	23	61.0	112	550	10.75					

VALUE EXCEEDED 'P' PERCENT OF TIME

P95 = 0.97
P90 = 1.4
P75 = 2.6
P70 = 3.0
P50 = 5.8
P25 = 19.1
P10 = 67.6

APPENDIX D. (CONTINUED)

WABASH RIVER BASIN

03326070 BIG LICK CREEK NEAR HARTFORD CITY, IN--Continued

LOWEST MEAN DISCHARGE AND RANKING FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183
1973	1.19 10	1.30 9	1.40 8	1.80 10	2.60 13	11.00 13	16.00 13	18.00 13	26.00 13
1974	1.70 12	1.70 12	1.80 13	2.00 11	2.40 11	2.60 7	3.00 7	7.30 12	11.00 10
1975	0.66 5	0.79 6	0.89 5	0.93 4	1.50 5	1.60 5	1.90 5	2.10 5	4.50 4
1976	0.97 8	1.10 8	1.50 9	1.50 8	2.00 8	5.20 12	5.50 12	6.50 9	9.30 8
1977	0.44 2	0.53 2	0.57 2	0.62 2	0.68 2	0.94 3	1.10 2	1.19 1	1.19 1
1978	0.54 3	0.60 3	0.85 4	0.98 5	1.10 4	1.30 4	1.80 4	1.90 4	4.80 5
1979	0.64 4	0.69 4	0.90 6	1.10 6	1.60 6	2.90 10	5.20 10	5.00 8	8.60 7
1980	0.96 7	0.99 7	1.19 7	1.30 7	1.80 7	2.80 9	4.60 9	7.30 10	11.00 11
1981	1.19 9	1.40 10	1.70 10	1.80 9	2.20 10	2.60 8	2.70 6	4.70 7	9.70 9
1982	1.70 13	1.70 13	1.80 11	2.00 12	2.60 12	4.70 11	5.50 11	7.30 11	12.00 12
1983	0.71 6	0.75 5	0.78 3	0.80 3	0.87 3	0.92 2	1.10 3	1.80 3	3.50 3
1984	0.19 1	0.23 1	0.32 1	0.50 1	0.55 1	0.67 1	0.94 1	1.19 2	2.30 2
1985	1.50 11	1.60 11	1.80 12	2.10 13	2.10 9	2.50 6	3.50 8	3.60 6	7.00 6

HIGHEST MEAN DISCHARGE AND RANKING FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1	3	7	15	30	60	90	120	183
1972	515.00 10	383.00 6	227.00 9	149.00 8	118.00 7	60.00 8	62.00 9	52.00 11	45.00 8
1973	542.00 9	289.00 12	145.00 12	136.00 11	104.00 10	78.00 10	60.00 10	54.00 10	57.00 4
1974	453.00 12	349.00 8	246.00 7	176.00 7	109.00 9	86.00 6	72.00 5	67.00 4	55.00 5
1975	602.00 7	329.00 10	182.00 11	116.00 12	79.00 12	63.00 11	58.00 11	56.00 9	44.00 9
1976	546.00 8	358.00 7	287.00 5	201.00 5	144.00 4	92.00 5	70.00 6	58.00 8	41.00 10
1977	404.00 13	195.00 14	141.00 13	88.00 14	57.00 14	38.00 14	31.00 14	24.00 14	16.00 14
1978	615.00 5	520.00 4	405.00 1	294.00 1	193.00 1	115.00 3	87.00 3	70.00 3	58.00 3
1979	504.00 11	333.00 9	201.00 10	145.00 10	84.00 11	61.00 12	44.00 12	40.00 12	32.00 12
1980	697.00 4	472.00 5	238.00 8	146.00 9	111.00 8	80.00 9	65.00 7	59.00 6	52.00 7
1981	1580.00 1	732.00 1	360.00 3	237.00 2	179.00 3	136.00 2	104.00 2	83.00 2	62.00 2
1982	841.00 3	559.00 3	337.00 4	221.00 4	191.00 2	138.00 1	112.00 1	96.00 1	66.00 1
1983	366.00 14	209.00 13	137.00 14	103.00 13	68.00 13	48.00 13	34.00 13	30.00 13	28.00 13
1984	605.00 6	328.00 11	258.00 6	181.00 6	117.00 6	84.00 7	76.00 4	62.00 5	53.00 6
1985	1100.00 2	729.00 2	37[illegible].00 2	225.00 3	139.00 5	93.00 4	64.00 8	58.00 7	41.00 11

ANNUAL VALUES

ANNUAL MEAN DISCHARGE AND RANKING
IN YEAR ENDING MARCH 31

1973	47.00 12
1974	32.00 11
1975	27.00 7
1976	28.00 8
1977	8.30 1
1978	25.00 5
1979	24.00 4
1980	27.00 6
1981	22.00 3
1982	59.00 13
1983	12.00 2
1984	29.00 10
1985	28.00 9

ANNUAL MEAN DISCHARGE AND RANKING
IN YEAR ENDING SEPTEMBER 30

1972	32.00 6
1973	37.00 1
1974	30.00 7
1975	26.00 9
1976	23.00 10
1977	9.20 14
1978	33.00 5
1979	21.00 12
1980	35.00 2
1981	35.00 3
1982	35.00 4
1983	15.00 13
1984	30.00 8
1985	23.00 11

APPENDIX D. (CONTINUED)

WABASH RIVER BASIN

03326070 BIG LICK CREEK NEAR HARTFORD CITY, IN--Continued

NORMAL MONTHLY MEANS (ALL DAYS)

YEAR	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
1971	*	*	*	*	*	*	*	*	*	1.41	2.42	3.30
1972	3.59	1.57	47.50	30.50	6.72	46.50	112.00	24.10	23.50	24.30	11.80	55.00
1973	17.40	87.20	63.70	26.50	21.70	96.00	46.60	13.10	41.80	6.94	20.20	2.97
1974	2.57	25.20	50.60	92.70	41.70	45.90	41.90	38.90	13.10	4.02	1.99	2.00
1975	1.63	5.29	45.00	49.90	73.40	50.90	36.50	7.55	26.00	2.72	11.20	2.58
1976	9.43	8.74	30.60	39.00	109.00	51.10	4.85	4.19	12.60	2.87	1.30	0.83
1977	1.65	1.26	1.63	0.76	30.00	39.60	13.00	11.70	1.77	1.11	2.45	7.04
1978	12.20	8.39	77.90	5.56	3.41	152.00	71.60	32.10	4.21	15.90	10.60	2.56
1979	3.40	14.70	25.50	23.60	21.90	65.80	38.20	9.21	27.60	7.83	15.30	3.40
1980	2.31	46.20	39.60	11.70	24.70	99.90	37.60	10.50	66.60	29.40	45.90	2.90
1981	3.31	2.26	10.80	8.32	40.00	11.20	45.50	114.00	148.00	17.30	9.27	9.66
1982	6.35	6.19	23.90	84.20	91.30	150.00	37.20	7.26	10.00	2.80	3.49	0.95
1983	0.92	4.49	44.90	6.42	18.30	9.38	57.80	31.00	2.25	1.61	1.08	0.61
1984	2.88	25.20	60.20	5.04	63.60	94.60	69.20	17.90	10.20	10.80	5.44	2.36
1985	2.90	10.70	25.40	23.10	97.80	64.70	31.50	7.56	7.67	2.21	2.10	2.24

	OCT	NOV	DEC	JAN	FEB	MARCH
TWENTY FIFTH PERCENTILE	2.14	3.93	25.00	6.20	20.80	44.30
FIFTIETH PERCENTILE	3.10	8.56	42.20	23.30	35.00	57.90
SEVENTY FIFTH PERCENTILE	7.12	25.19	53.00	41.70	77.90	97.00

	APRIL	MAY	JUNE	JULY	AUG	SEPT
TWENTY FIFTH PERCENTILE	35.20	7.56	6.80	2.21	2.10	2.00
FIFTIETH PERCENTILE	40.00	12.40	12.90	4.02	5.44	2.58
SEVENTY FIFTH PERCENTILE	60.60	31.30	31.10	15.90	11.80	3.40

[illegible]

COVER DESIGN BY ALDO GIORGINI